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RADIOLOGICAL HEALTH DATA

QUARTERLY REPORT

OCTOBER 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Radiological Health

3<

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing *Radiological Health Data*. This publication is issued monthly, with each third issue (starting July 1960) expanded somewhat into a quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

TABLE OF CONTENTS

Page
PREFACE ... iii

SECTION I.—MILK

Public Health Service Milk Monitoring Program ... 1
  Data on Radioactivity in Milk (May 1960) ... 3
Data on Radioactivity in Milk at Honolulu, Hawaii (January—March 1960)—Health and Safety Laboratory, U.S. Atomic Energy Commission ... 5

SECTION II.—AIR

Public Health Service Radiation Surveillance Network ... 6
  Data on Radioactivity of Particulates in Air—Gross Beta Counts (May 1960) ... 8
  Data on Radon and Thoron Air Measurements at Cincinnati, Ohio (May 1960) ... 9
Public Health Service National Air Sampling Network ... 10
  Gross Beta Radioactivity in Air (1959) ... 12

SECTION III.—WATER

Public Health Service National Water Quality Network ... 16
  Data on Radioactivity in Raw Surface Waters (April 1960) ... 18
  Radioactivity of Surface Waters in the United States ... 20

SECTION IV.—OTHER DATA

External Gamma Activity—Public Health Service Radiation Surveillance Network (May 1960) ... 32
Daily Intake of Calcium and Strontium-90 from Environmental Sources—Public Health Service ... 33
Concentration of Strontium-90 in Whole Wheat and White Bread Purchased in New York City in 1958-60.—Health and Safety Laboratory, U. S. Atomic Energy Commission ... 34
Estimated Daily Per Capita Intake of Wheat Milling Products and the Relative Contribution of Sr^{90} From Such Products to the Total Diet—Public Health Service ... 35
Strontium-90 in Milk and Agricultural Materials in the United Kingdom (1958-1959)—United Kingdom Agricultural Research Council ... 40
Estimate of Strontium-90 in the Diet of New York City Infants Nurtured on Commercially Processed Baby Foods and Milk—Health and Safety Laboratory, U. S. Atomic Energy Commission ... 41
Food Consumption of Households in the United States, Southern and Western Regions (1955)—U.S. Department of Agriculture ... 45
The Cesium-Potassium Trend in Humans at Chicago as a Function of Time—Argonne National Laboratory ... 63
Delaware River Surveillance Summary Report—Public Health Service ... 64
Radioactive Fallout From Nuclear Detonations of February and April 1960—Division of Biology and Medicine, U. S. Atomic Energy Commission ... 66
Fallout Studies—U. S. Atomic Energy Commission ... 66

LIST OF TABLES

Page

I.—Data on Radioactivity in Milk (May 1960)—Robert A. Taft Sanitary Engineering Center—Public Health Service 3
II.—Data on Radioactivity in Milk (May 1960)—Southwestern Radiological Health Facility—Public Health Service 4
III.—Data on Radioactivity in Milk (May 1960)—Southeastern Radiological Health Facility—Public Health Service 4
IV.—Strontium-90 and Calcium in Honolulu Liquid Milk (January—March 1960)—Health and Safety Laboratory, Atomic Energy Commission 5
V.—Radioactivity of Particulates in Air—Gross Beta Counts (May 1960)—Public Health Service Radiation Surveillance Network 8
VI.—Radon and Thoron Measurements (May 1960)—Public Health Service Radiation Surveillance Network 9
VII.—Gross Beta Radioactivity in Air (1959)—Public Health Service National Air Sampling Network 12
VIII.—Radioactivity in Raw Surface Water (April 1960)—Public Health Service National Water Quality Network 18
IX.—External Gamma Activity (May 1960)—Public Health Service Radiation Surveillance Network 32
X.—Daily Intake of Calcium and Strontium-90 From Environmental Sources—Public Health Service 33
XI.—Strontium-90 and Calcium in Bread Purchased in New York City—Health and Safety Laboratory, Atomic Energy Commission 34
XII.—Estimates of Strontium-90 in United States Diets—Health and Safety Laboratory, Atomic Energy Commission 39
XIII.—Food Consumption Per Person in Households in the Southern Region of the United States (1955)—U. S. Department of Agriculture 47
XIV.—Food Consumption Per Person in Households in the Western Region of the United States (1955)—U. S. Department of Agriculture 55
XV.—Cesium-137 Potassium-40 Ratios in Eight Control Subjects—Argonne National Laboratory ... 63

LIST OF FIGURES

1.—Public Health Service Radiation Surveillance Network Sampling Stations 7
2.—Public Health Service National Air Sampling Network Sampling Stations 11
3.—Public Health Service National Water Quality Network Sampling Stations 17
4.—Food Consumption Survey Regions - U. S. Department of Agriculture 46

SECTION I.—MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The original Public Health Service Milk Monitoring Program consisted of 12 sampling stations. This is now being expanded to about 60 stations. Since the sampling procedures for the original and the added stations are somewhat different, they will be described and reported separately. The Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, conducts the analyses for the original network stations and the Public Health Service Southeastern Radiological Health Facility, Montgomery, Alabama, and the Southwestern Radiological Health Facility, Las Vegas, Nevada, for the added stations.

Original Stations

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing since it is among the most important elements of the diet and is constantly available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs.

The selection of the original sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.
2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.
3. The milk samples were from a supply that was part of a metropolitan milkshed.
4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000 cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000 gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, and the strontium-90 is calculated by measuring the build-up of the daughter decay product, yttrium-90 (after about a two week wait) using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

Publication of the data will normally require a period of about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

April through September 1960 issues of Radiological Health Data list references for technical descriptions of the methodology of analyses used.

Table I presents the results of analyses for the original stations for April 1960.

7<

Added Stations

The Milk Monitoring Program is being expanded for the primary purpose of providing additional information on levels of radiation in milk consumed by the public. The new stations are being established in cooperation with State and local health and milk sanitation agencies. The cities have been selected in order to provide adequate coverage from the combined viewpoints of production areas and consuming population. The emphasis on this expanded sampling and radioassay program is that of:

1. Measuring the radioactivity levels of the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the point of distribution to the public.

2. Providing one sampling point within each state with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of large population groups. This differs from the original set of sampling stations whose selection was based principally upon certain criteria involving the milk production and milkshed area characteristics.

In some instances the designated points are the same as those which reported originally. The establishment of the added sampling stations does not preclude the need for further samples from the selected milksheds serving the same cities. It is important that both networks be in operation for a sufficient period of time to provide an overlap for purposes of comparative study.

The sampling procedure has been developed to give a sample from one day's sales per month in a community which will be as representative of the total supply as can be achieved under practical conditions. The sample will be a composite of those plants supplying not less than 90% of the city's milk supply. The contribution from each plant to the total sample will be approximately proportional to volume of milk sold.

The samples from the added stations are collected with the assistance of the various State and local health and milk sanitation agencies and shipped for analysis to either the Southwestern or Southeastern Radiological Health Facility. The Southeastern Radiological Health Facility processes samples from the 30 states east of the Mississippi, and the Southwestern Radiological Health Facility from the States generally west of the Mississippi River.

At the present time radioassays for Sr^{90} and Cs^{137} are being performed. As the laboratories increase their capacities and instrumentation, a selected group of radionuclides of concern to public health agencies will be included for assay as necessary for complete monitoring of the milk supply.

The data from the Southwestern Radiological Health Facility and the Southeastern Radiological Health Facility for May 1960 is presented in Table II and Table III.

TABLE I.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Robert A. Taft Sanitary Engineering Center

May 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	May	Yearly average	May	Yearly average	May	Yearly average	May	Yearly average	May	Yearly average	May	Yearly average
Atlanta, Ga.	1.15	1.14	0	4	0	8	19.8	16.1	0	0	40	66
Austin, Tex.	1.04	1.10	0	2	0	4	4.5	5.4	0	0	20	33
Chicago, Ill.	1.05	1.09	0	0	0	5	14.6	9.7	0	0	45	47
Cincinnati, Ohio	1.15	1.12	0	0	0	5	8.3	11.6	0	0	15	36
New York, N. Y.	1.05	1.07	0	1	0	5	12.3	10.4	0	0	40	45
Overton, Nev.	1.04	1.08	0	0	0	<1	3.8	3.3	0	0	15	24
Sacramento, Calif.	1.11	1.09	0	0	0	2	4.1	3.8	0	0	10	27
Salt Lake City, Utah	1.06	1.10	0	<1	0	4	8.4	7.6	0	0	35	45
Spokane, Wash.	1.10	1.13	0	<1	0	9	15.2	13.0	0	0	45	61
St. George, Utah	NO SAMPLE COLLECTED											
St. Louis, Mo.	1.17	1.24	0	0	0	13	23.3	20.2	0	0	35	55

Samples are taken at one sampling point from the milk supply of the areas listed above.

9<

TABLE II.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southwestern Radiological Health Facility

May 1960

(Radioactivity in $\mu\mu$c/liter)

Area	Calcium grams/liter		Strontium-89		Strontium-90	
	May	Average to date	May	Average to date	May	Average to date
Albuquerque, N. Mex.[1]	1.2	1.2	[4]0	0	3.8	3.6
Denver, Colo.[1]	1.2	1.18	0	0	7.9	7.7
Honolulu, Hawaii[2]	1.0	1.05	0	2.4	5.1	3.6
Idaho Falls, Idaho[1]	1.1	1.03	0	3.0	6.4	8.3
Kansas City, Mo.[2]	1.1	1.15	5.2	9.6	8.5	7.6
Laramie, Wyo.[2]	1.1	1.1	0	3.0	5.4	6.0
Las Vegas, Nev.[2]	1.2	1.15	0	0	2.9	2.8
Palmer, Alaska[1]	1.1	1.1	0	0	6.7	6.6
Portland, Oreg.[2]	1.2	1.1	0	8.8	14.7	11.6
Salt Lake City, Utah[1]	1.1	1.13	0	0	6.1	4.7
Seattle, Wash.[2]	1.1	1.1	0	8.0	12.5	8.6
Spokane, Wash.[3]	1.1	-	0	-	10.7	-
Wichita, Kans.[2]	1.1	1.15	0	5.9	8.5	6.5

[1] Average of first three months.
[2] Average of two months (Las Vegas is average of March and May).
[3] Initial sample.
[4] Zero means calculated value is less than twice error at 95% confidence level.

TABLE III.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southeastern Radiological Health Facility

May 1960

(Radioactivity in $\mu\mu$c/liter)

Area	Calcium grams/liter		Strontium-90		Cesium-137	
	May	Average to date*	May	Average to date*	May	Average to date*
Burlington, Vt.	1.22	1.22	9	10	30	30
Charleston, W. Va.	1.24	1.18	8	8	10	10
Hartford, Conn.	1.21	1.21	9	9	30	20
Louisville, Ky.	1.38	1.25	7	6	<20	<20
Manchester, N. H.	1.29	1.32	10	13	50	50
Pittsburgh, Pa.	1.24	1.24	14	14	20	20
Syracuse, N. Y.	1.27	1.24	8	7	30	30

Note: Sr^{89} analysis performed, but no significant amounts detected.
* Average of April and May values.

350

DATA ON RADIOACTIVITY IN MILK AT HONOLULU, HAWAII

Atomic Energy Commission Health and Safety Laboratory

Data for three milk sampling stations, New York City, N. Y., Perry, N. Y. and Mandan, North Dakota for January, February and March 1960 were published in the August 1960 issue of Radiological Health Data. Sampling at a fourth station began in August 1959 at Honolulu, Hawaii. The analyses are conducted at the Atomic Energy Commission's Health and Safety Laboratory in New York. Table IV presents the data for Honolulu.

TABLE IV.—STRONTIUM-90 AND CALCIUM IN HONOLULU LIQUID MILK

Month	Strontium-90		Calcium
	μμc/liter	μμc/gm Ca	gm/liter
January	3.60	3.35	1.07
January	4.66	4.17	1.12
February	3.41	3.51	0.98
February	3.46	3.52	0.99
March	5.71	5.17	1.10
March	3.68	3.57	1.03

Two results per month represent milk from two different dairies.

351

SECTION II.—AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout during nuclear weapons tests. The program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 45 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to a laboratory in Washington for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 45 stations on an average of 70% of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85% of the stations collect samples of precipitation which are sent to Washington for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table V presents a summary of the latest monthly data.

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK
SAMPLING STATIONS

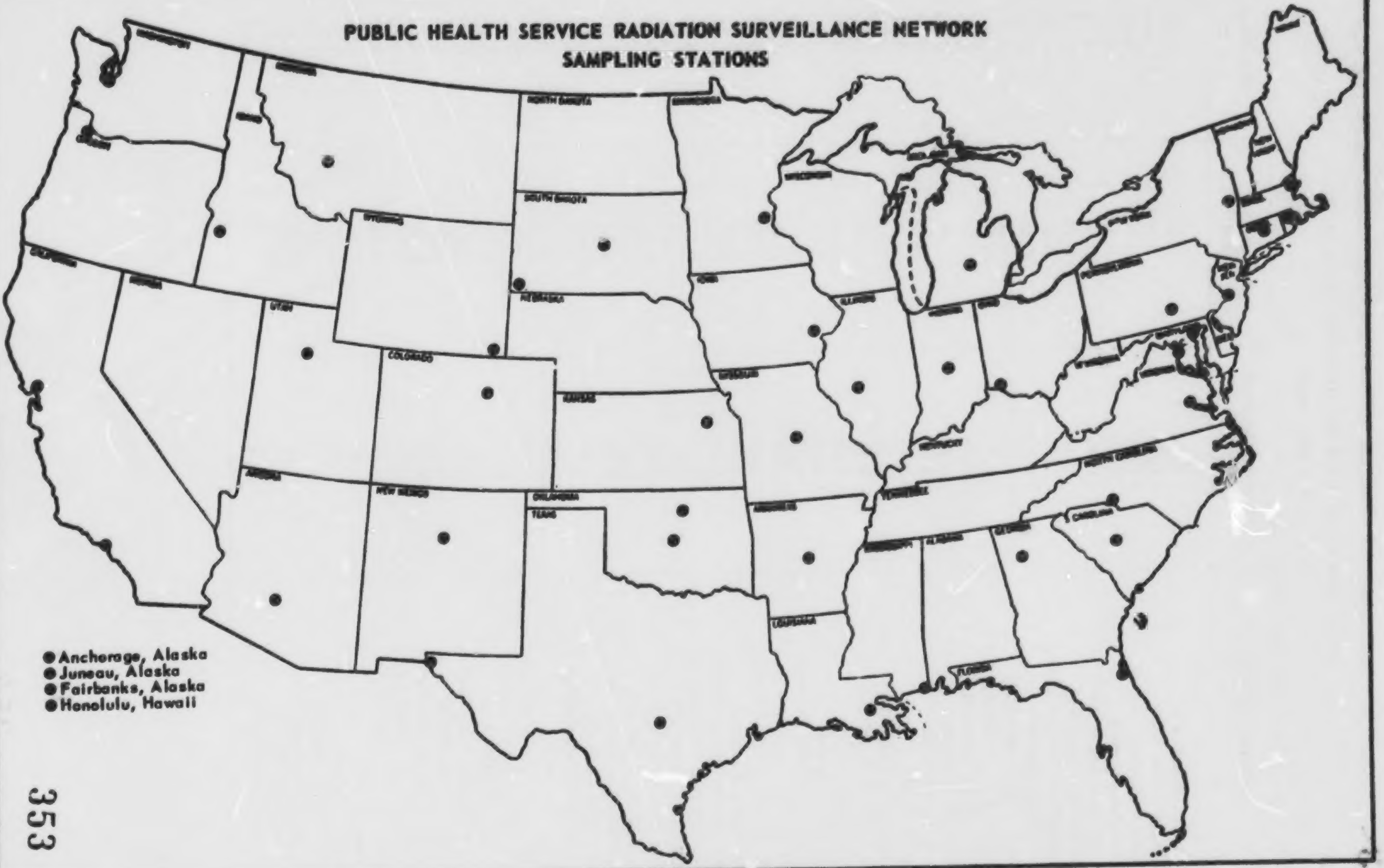

● Anchorage, Alaska
● Juneau, Alaska
● Fairbanks, Alaska
● Honolulu, Hawaii

FIGURE 1

353

12<

13<

TABLE V.—RADIOACTIVITY OF PARTICULATES IN AIR—GROSS BETA COUNTS

Public Health Service Radiation Surveillance Network

May 1960

Station location	Weighted average $\mu\mu c/m^3$	Maximum $\mu\mu c/m^3$	Minimum $\mu\mu c/m^3$
Alaska, Anchorage	< 0.11	0.18	< 0.10
Alaska, Fairbanks	< 0.18	0.38	< 0.10
Alaska, Juneau	< 0.12	0.23	< 0.10
Arizona, Phoenix	0.35	0.57	0.21
Arkansas, Little Rock	< 0.21	0.34	< 0.10
California, Berkeley	< 0.11	0.24	< 0.10
California, Los Angeles	< 0.15	0.42	< 0.10
Colorado, Denver	< 0.23	0.36	< 0.10
Connecticut, Hartford	< 0.16	0.23	< 0.10
District of Columbia	< 0.20	0.58	< 0.10
Florida, Jacksonville	< 0.19	0.36	< 0.10
Georgia, Atlanta	< 0.25	0.38	< 0.10
Hawaii, Honolulu	< 0.10	0.23	< 0.10
Idaho, Boise	0.23	0.24	0.11
Illinois, Springfield	< 0.22	0.53	< 0.10
Indiana, Indianapolis	< 0.17	0.37	< 0.10
Iowa, Iowa City	< 0.20	0.40	< 0.10
Kansas, Topeka	< 0.18	0.36	< 0.10
Louisiana, New Orleans	0.22	0.29	0.14
Maryland, Baltimore	< 0.26	0.47	< 0.10
Massachusetts, Lawrence	< 0.12	0.20	< 0.10
Michigan, Lansing	< 0.18	0.40	< 0.10
Minnesota, Minneapolis	< 0.17	0.34	< 0.10
Mississippi, Pascagoula	< 0.10	< 0.10	< 0.10
Missouri, Jefferson City	< 0.18	0.29	< 0.10
Montana, Helena	< 0.16	0.27	< 0.10
New Jersey, Trenton	< 0.17	0.29	< 0.10
New Mexico, Santa Fe	< 0.24	0.38	< 0.10
New York, Albany	< 0.19	0.76	< 0.10
North Carolina, Gastonia	< 0.26	0.41	< 0.10
Ohio, Cincinnati	0.88	3.50	0.20
Oklahoma, Oklahoma City	< 0.22	0.34	< 0.10
Oklahoma, Ponca City	< 0.19	0.31	< 0.10
Oregon, Portland	< 0.12	0.24	< 0.10
Pennsylvania, Harrisburg	< 0.20	0.44	< 0.10
Rhode Island, Providence	< 0.16	0.25	< 0.10
South Carolina, Columbia	< 0.22	0.33	< 0.10
South Dakota, Edgemont	< 0.35	0.87	< 0.10
South Dakota, Pierre	0.27	0.43	0.18
Texas, Austin	< 0.19	0.34	< 0.10
Texas, El Pasco	0.34	0.77	0.19
Utah, Salt Lake City	< 0.22	0.42	< 0.10
Virginia, Richmond	< 0.16	0.39	< 0.10
Washington, Seattle	< 0.10	0.11	< 0.10
Wyoming, Cheyenne	0.18	0.25	0.12

TABLE VI.—RADON AND THORON MEASUREMENTS

Public Health Service Radiation Surveillance Network
Cincinnati, Ohio

May 1960

Date	Continuous sample collection			Radon (a) PM $\mu\mu c/m^3$	Radon (b) AM $\mu\mu c/m^3$	Thoron (c) $\mu\mu c/m^3$	Beta (d) activity $\mu\mu c/m^3$
	Sample change time	Sampling period (hours)	Volume m^3				
May 2	0810	72.1	83.1	65	555	7.7	1.1
3	0815	24.0	28.5	87	780	8.5	2.8
4	0800	23.7	28.3	86	840	9.3	3.5
5	0801	23.9	28.0	106	570	8.6	2.2
6	0815	24.1	28.8	68	228	4.5	0.5 (3)
9	0813	71.8	83.6	47	105	3.1	0.5
10	0814	23.9	28.2	56	73	1.0	0.3
11	0808	23.8	28.3	97	139	1.2	0.6
12	0802	23.8	28.4	99	134	1.6	0.6
13	0814	24.1	28.8	49	150	1.4	0.3 (3)
16	0810	71.8	84.9	152	697	12.0	0.3
17	0815	24.0	28.1	96	259	4.4	1.7
18	0805	23.8	28.3	94	148	2.4	1.9
19	0807	24.0	28.2	183	322	4.9	1.4
20	0825	24.2	28.5	100	341	5.7	0.3 (3)
23	0809	71.7	84.7	83	500	5.7	0.6
24	0806	23.9	28.2	85	322	5.6	1.7
25	0804	23.9	28.7	137	161	2.1	0.6
26	0806	24.0	28.8	94	160	2.4	1.0
27	0810	24.0	28.8	91	170	1.2	0.2 (4)
31	0810	95.9	113.9	15	152	1.3	0.3
	Average....................................			85	290	4.0	0.9

(a) Filters are temporarily withdrawn from samplar at about 3 p.m. and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 a.m. the following day.

(b) Measured within a few minutes of removal of filter from samplar and corrected back to collection time (uncorrected for thoron daughter interference).

(c) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

(d) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

PUBLIC HEALTH SERVICE NATIONAL AIR SAMPLING NETWORK

The Public Health Service developed its National Air Sampling Network to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, climate, and other factors associated with air quality.

The Network consists of 103 sampling stations operating every year, of which 66 are in large cities and 37 are in nonurban areas. In addition to these every year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Network Stations appeared in the May 1960 issue of Radiological Health Data.

The Network stations are manned by cooperating federal, state, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2,000 cubic meters of air are collected on glass fiber filters on a bi-weekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

Quarterly reports of individual sample data and annual summaries are distributed to all participating agencies and state health departments. A comprehensive report on the first five years of operation of the Network is contained in the publication, Air Pollution Measurements of the National Air Sampling Network, Public Health Service Publication No. 637, 1958; for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price $2.00. Gross beta activity, by States, for the years 1953 through 1958 was submitted by Dr. F. J. Weber, Chief of the Division of Radiological Health, Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 173-185.

Quarterly averages of the gross beta activity of particulates in air will be published in the Radiological Health Data quarterly reports. Table VII presents the data for the four quarters of 1959 and the yearly average.

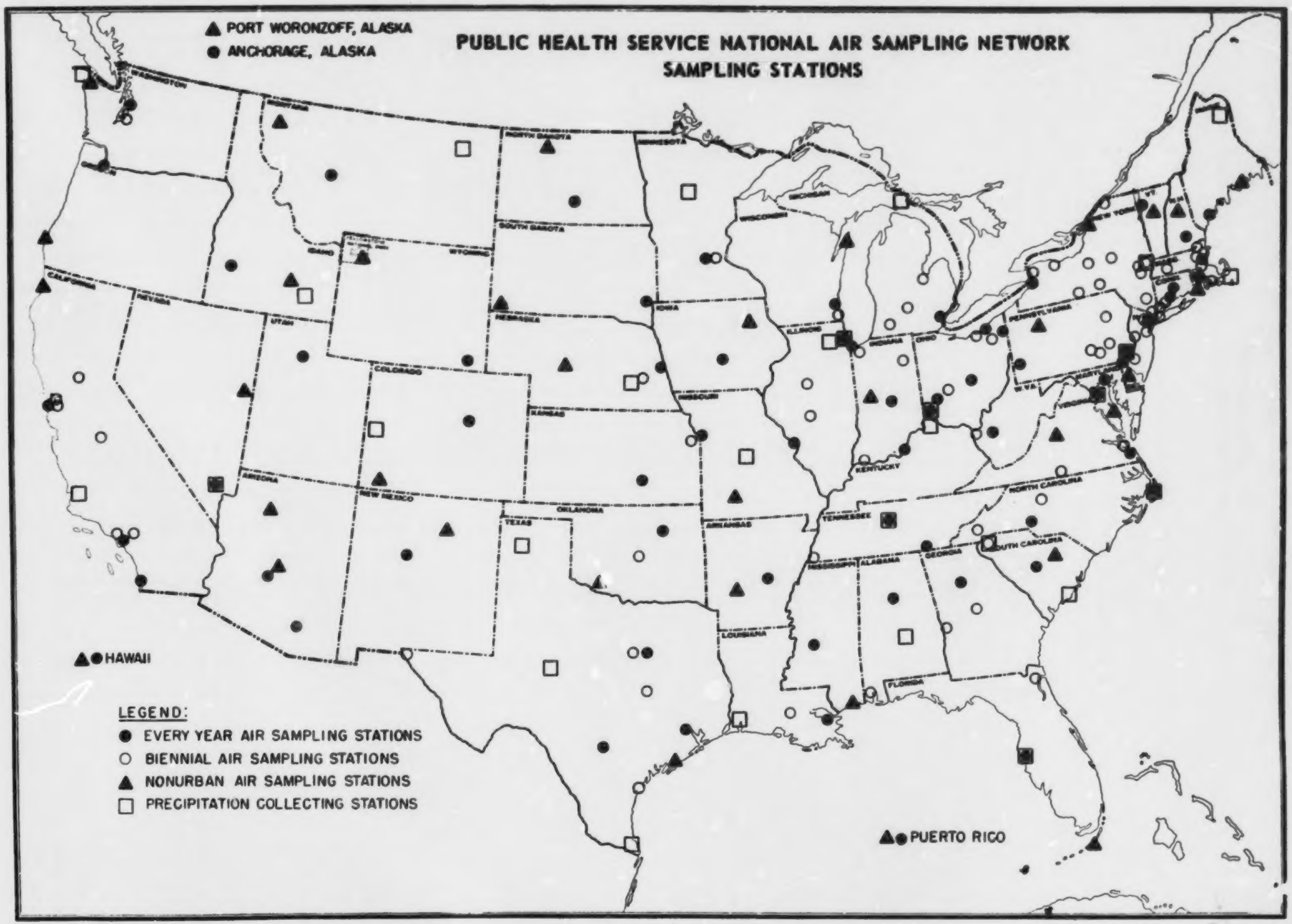

▲ PORT WORONZOFF, ALASKA
● ANCHORAGE, ALASKA
PUBLIC HEALTH SERVICE NATIONAL AIR SAMPLING NETWORK
SAMPLING STATIONS
▲● HAWAII
LEGEND:
● EVERY YEAR AIR SAMPLING STATIONS
○ BIENNIAL AIR SAMPLING STATIONS
▲ NONURBAN AIR SAMPLING STATIONS
□ PRECIPITATION COLLECTING STATIONS
▲● PUERTO RICO

FIGURE 2

17<

TABLE VII.—GROSS BETA RADIOACTIVITY IN AIR

National Air Sampling Network
Public Health Service

1959

(picocuries per cubic meter)[1]

Station	First quarter		Second quarter		Third quarter		Fourth quarter		Yearly average	
	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**
New Britain, Conn.	6	7.0	7	4.4	6	0.5	6	0.1	25	3.0
Hartford, Conn.	7	6.3	6	5.2	6	0.6	7	0.1	26	3.0
New Haven, Conn.	5	8.3	5	6.8	6	0.6	7	0.1	23	3.4
Litchfield Co. Conn.*	7	6.6	6	6.6	5	0.9	7		25	3.6
Portland, Maine	6	7.4	5	7.0	7	0.8	3	0.1	21	4.0
Acadia Nat. Pk., Maine*	6	12.9	6	6.4	7	1.0	7	0.1	26	4.7
Boston, Mass.	6	10.5	7	7.4	6	0.7	7	0.1	26	4.6
Worcester, Mass.	7	8.0	6	9.2	6	0.9	6		25	4.7
Brockton, Mass.	6	6.4	6	3.8	5	0.6	5		22	2.9
Fall River, Mass.	6	5.2	4	3.2	4	0.1	2		16	(***)
Quincy, Mass.	5	5.4	6	4.9	7	0.3	6		24	2.5
Springfield, Mass.	6	5.7	7	4.8	4	1.4	6		23	3.2
Cambridge, Mass.	6	7.0	7	7.4	5	0.6	7	0.1	25	3.9
Lowell, Mass.	5	7.7	5	5.4	5	0.6	7		22	3.1
New Bedford, Mass.	6	7.0	6	4.0	7	0.5	6	0.1	25	2.8
Nantucket, Mass.*	7	6.4	6	6.8	6	0.7	7		26	3.4
Manchester, N. H.	4	9.3	5	5.2	6	0.4	6		21	3.1
Coos County, N. H.*	6	6.4	7	4.8	7	0.7	5		25	3.1
Providence, R. I.	7	6.8	6	3.9	6	0.8	7	0.1	26	2.9
Washington Co., R. I.*	6	7.6	6	3.5	8	0.4	6	0.1	26	2.7
Burlington, Vt.	6	8.1	7	3.5	6	0.7	7	0.1	26	3.0
Orange Co., Vt.*	-	-	-	-	-	-	4	0.1	4	(***)
Wilmington, Del.	6	6.6	2	3.4	5	0.3	7	0.1	20	2.4
Kent County, Del.*	6	10.5	7	5.0	6	0.6	7	0.1	26	3.9
Jersey City, N. J.	6	8.7	7	4.3	6	0.5	7	0.1	26	3.3
Newark, N. J.	6	4.2	7	4.0	6	0.7	5	0.1	24	2.4
Bayonne, N. J.	4	9.2	1	5.6	3	1.5	1	0.2	9	(***)
Paterson, N. J.	5	5.0	4	9.6	5	0.6	1	0.2	15	(***)
Cape May, N. J.	4	12.9	6	7.0	5	0.3	2	0.2	17	(***)
New York, N. Y.	6	7.6	8	8.8	7	0.4	6		26	4.4
Binghamton, N. Y.	6	10.0	7	5.3	6	0.9	6	0.1	25	4.1
Buffalo, N. Y.	5	8.2	7	9.1	2	1.9	-	-	14	(***)
Schenectady, N. Y.	6	6.5	7	3.3	6	1.2	5	0.1	24	2.9
Syracuse, N. Y.	6	7.7	7	6.4	6	1.0	6	0.1	25	3.9
Utica, N. Y.	6	6.3	6	6.9	7	1.1	7	0.1	26	3.4
Rochester, N. Y.	7	8.7	6	17.2	7	1.3	3	0.1	23	7.5
Yonkers, N. Y.	6	6.5	7	5.9	1	0.2	3	0.1	17	(***)
Niagara Falls, N. Y.	6	7.2	6	4.7	5	0.7	5	0.1	22	3.4
New Rochelle, N. Y.	6	7.9	4	6.3	8	0.8	5		23	3.4
Troy, N. Y.	6	8.1	7	5.7	5	0.7	6	0.1	24	3.8
Massena, N. Y.	4	5.3	6	8.4	4	0.4	6	0.1	20	3.7
Glen Cove, N. Y.	6	14.1	6	6.1	4	0.6	6	0.1	22	3.7
Elmira, N. Y.	6	13.7	7	8.4	5	1.0	7		25	5.9
Cape Vincent, N. Y.*	1	7.0	4	5.4	3	0.5	5	0.1	13	(***)
Philadelphia, Pa.	6	7.7	7	6.2	6	0.7	3	0.1	22	4.3
Altoona, Pa.	7	5.4	6	6.9	3	0.9	-	-	16	(***)

358

TABLE VII.—GROSS BETA RADIOACTIVITY IN AIR—Con.

National Air Sampling Network
Public Health Service

1959

(picocuries per cubic meter)[1]

Station	First quarter		Second quarter		Third quarter		Fourth quarter		Yearly average	
	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**
Erie, Pa.	6	6.2	7	2.9	7	0.8	2	0.3	22	2.9
Pittsburg, Pa.	6	10.4	7	7.2	6	0.9	4	0.2	23	5.2
Allentown, Pa.	7	3.6	6	5 9	7	0.7	6		26	2.5
Johnstown, Pa.	6	6.4	7	6.7	6	0.7	3	0.2	22	4.3
Scranton, Pa.	7	7.4	5	5.6	7	1.6	7	0.1	26	3.5
York, Pa.	7	6.8	6	5.8	7	1.0	5	0.1	25	3.6
Clarion County, Pa.*	6	7.8	6	6.3	7	0.7	5		24	3.7
Washington, D. C.	6	9.6	5	6.4	5	0.3	6	0.1	22	4.1
Louisville, Ky.	5	8.7	5	10.0	4	0.7	3	0.1	17	(***)
Pulaski County, Ky.*	6	8.1	7	4.3	7	0.4	6	0.1	26	3.1
Baltimore, Md.	6	7.0	6	9.5	8	1.0	6	0.1	26	4.1
Calvert County, Md.*	6	6.2	7	4.2	6	0.4	7	0.1	26	2.7
Charlotte, N. C.	6	9.4	7	6.0	6	0.6	7	0.1	26	3.9
Raleigh, N. C.	6	9.1	6	6.1	7	0.6	6	0.1	25	3.8
Cape Hatteras, N. C.*	6	8.5	4	7.1	8	0.5	5	0.1	23	3.6
San Juan, P. R.	6	6.9	7	3.1	4	0.3	7		24	2.7
Loquillo Mins Pk, P. R.*	6	4.4	7	2.1	6	0.5	7		26	1.7
Norfolk, Va.	7	9.6	6	6.8	6	0.6	7		26	4.3
Richmond, Va.	6	11.9	8	6.4	6	0.3	7	0.1	26	4.8
Roanoke, Va.	6	8.8	6	9.2	8	0.4	4	0.2	24	4.7
Danville, Va.	-	-	5	4.9	8	0.5	4	0.1	17	(***)
Shenandoah Nat. Pk., Va.*	6	8.6	7	7.5	6	0.6	7	0.1	26	4.2
Charleston, W. Va.	7	9.1	4	3.4	7	0.5	6		24	3.4
Wheeling, W. Va.	6	9.3	7	6.2	4	0.9	3	0.2	20	5.2
Webster County, W. Va.*	5	6.8	7	4.2	4	0.2	6	0.1	22	2.9
Birmingham, Ala.	6	13.2	7	5.3	6	0.5	7		26	4.6
Montgomery, Ala.	6	7.8	7	6.9	7	0.5	5	0.1	25	4.4
Baldwin County, Ala. *	7	9.1	6	5.6	5	0.4	5	0.1	23	4.4
Tampa, Fla.	6	9.2	7	5.3	6	0.4	7		26	3.7
Miami, Fla.	6	12.8	7	5.3	6	0.4	5	0.1	24	4.9
Orlando, Fla.	6	10.6	4	5.5	7	0.4	7	0.1	24	3.7
Florida Keys, Fla.*	2	14.2	11	3.5	6	0.2	7		26	2.6
Atlanta, Ga.	6	13.8	6	6.0	6	0.7	6	0.1	24	5.1
Savannah, Ga.	7	7.9	5	5.3	6	0.5	5		23	3.7
Chatham County, Ga.*	6	9.3	6	8.0	8	0.5	5		25	4.3
Jackson, Miss.	6	8.1	7	6.6	6	0.6	7	0.1	26	3.8
Jackson County, Miss.*	5	8.5	5	4.8	8	0.4	7		25	2.8
Columbia, S. C.	7	11.2	6	11.0	6	0.4	2	0.1	21	7.0
Charleston, S. C.	6	11.4	6	7.0	6	0.3	6	0.1	24	4.7
Richland, County, S. C.	5	11.4	7	2.7	5	0.3	7	0.1	24	3.2
Chattanooga, Tenn.	7	8.4	6	5.3	6	0.6	7	0.1	26	3.7
Knoxville, Tenn.	6	7.1	6	7.3	8	0.5	6	0.1	26	3.5
Nashville, Tenn.	7	11.0	6	3.9	7	0.9	6		26	4.1
Stewart County, Tenn.*	4	5.1	7	5.1	6	0.6	5	0.1	22	2.7
Chicago, Ill.	6	7.6	5	10.6	3	1.3	5	0.1	19	(***)
Rockford, Ill.	6	5.7	7	5.8	6	0.5	7		26	3.0

TABLE VII.—GROSS BETA RADIOACTIVITY IN AIR—Con.

National Air Sampling Network
Public Health Service

1959

(picocuries per cubic meter)[1]

Station	First quarter		Second quarter		Third quarter		Fourth quarter		Yearly average	
	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**
Sangamon County, Ill.*	5	7.8	7	5.1	6	0.7	6	0.1	24	3.3
East Chicago, Ind.	5	6.4	6	3.9	6	0.5	6	0.1	23	2.6
Indianapolis, Ind.	6	8.2	4	8.3	5	0.4	6	0.1	21	4.0
Hammond, Ind.	7	6.4	5	4.1	6	0.5	7	0.1	25	2.7
South Bend, Ind.	3	4.3	7	8.4	7	1.2	7	0.1	24	3.4
Montgomery County, Ind.	4	8.5	3	4.2	4	0.5	6	0.1	18	(***)
Detroit, Mich.	7	9.4	7	8.0	7	0.9	7	0.1	26	4.5
Grand Rapids, Mich.	3	6.6	7	5.2	1	1.8	-	-	11	(***)
Flint, Mich.	7	9.0	6	7.5	6	1.0	7		26	3.1
Huron County, Mich.*	5	4.5	6	3.9	8	0.5	5	0.1	24	2.1
Dearborn, Mich.	7	6.5	6	5.4	6	0.6	7	0.1	26	3.1
Cincinnati, Ohio	7	7.5	7	7.1	6	1.0	9	0.1	26	3.7
Youngstown, Ohio	6	6.7	7	7.0	6	1.0	7	0.1	26	3.7
Canton, Ohio	7	6.3	6	7.6	6	0.8	7	0.1	26	3.7
Cleveland, Ohio	5	8.2	7	5.1	6	1.2	8	0.1	26	3.4
Columbus, Ohio	7	7.8	5	6.5	8	0.9	5	0.1	25	3.8
Toledo, Ohio	6	6.7	6	9.2	7	0.7	5	0.1	24	4.2
Dayton, Ohio	5	4.6	7	2.1	6	0.6	7	0.1	25	1.7
Hamilton, Ohio	6	7.8	7	6.8	6	1.0	7	0.1	26	3.9
South Bass Island, Ohio*	4	6.5	6	6.1	6	1.2	7	0.1	23	3.0
Milwaukee, Wis.	7	7.5	4	6.2	7	0.6	7		25	3.3
Madison, Wis.	6	5.7	7	5.3	6	1.0	7		26	3.0
Door County, Wis.*	6	7.3	6	7.7	3	0.2	4	0.1	19	(***)
Des Moines, Iowa	6	7.1	7	7.7	6	0.7	6	0.1	25	4.0
Clayton County, Iowa*	6	7.9	7	7.2	6	0.9	7	0.1	26	4.0
Wichita, Kans.	6	7.5	4	7.0	4	0.5	5	0.1	26	4.0
Topeka, Kans.	7	6.2	6	6.1	4	0.5	7	0.1	24	3.4
Minneapolis, Minn.	6	5.4	6	4.3	6	1.0	7	0.1	25	2.6
Duluth, Minn.	6	7.4	7	4.1	7	0.9	6		26	3.1
Cook County, Minn.	7	6.5	6	5.3	5	0.9	6	0.1	24	3.4
Kansas City, Mo.	5	7.1	8	4.8	5	1.2	5	0.1	23	3.5
St. Louis, Mo.	6	11.5	7	8.0	6	0.9	5	0.2	24	5.4
Shannon County, Mo.*	6	11.4	7	7.7	5	0.3	7	0.1	25	5.0
Omaha, Nebr.	5	8.1	5	5.9	6	0.7	5		21	3.5
Thomas County, Nebr.	6	9.2	5	4.4	8	0.6	5	0.1	24	3.4
Bismarck, N. D.	5	4.7	7	5.0	7	0.7	6	0.1	25	2.5
Ward County, N. D.*	6	2.6	5	5.8	7	1.2	7		25	2.1
Sioux Falls, S. D.	6	10.6	6	5.1	7	1.7	7	0.1	26	4.1
Black Hills Frst. S. Dak.*	5	12.6	5	8.7	6	2.0	3	0.1	19	6.3
Little Rock, Ark.	7	10.9	5	5.0	7	0.4	7	0.1	26	4.0
Montgomery County, Ark.*	6	10.0	7	5.7	7	0.5	6	0.1	26	4.0
New Orleans, La.	7	10.3	6	3.9	6	0.4	7		26	3.7
Shreveport, La.	8	7.8	5	4.5	8	0.6	7	0.1	26	3.0
St. Tammany Parish, La.*	6	11.4	8	5.5	6	0.3	6	0.1	26	4.4
Albuquerque, N. Mex.	5	14.0	6	6.3	6	0.4	7	0.1	24	4.6
Colfax County, N. Mex.*	5	17.4	7	5.9	3	0.7	6	0.1	21	6.2

20<

TABLE VII.—GROSS BETA RADIOACTIVITY IN AIR—Con.

National Air Sampling Network
Public Health Service

1959

(picocuries per cubic meter)[1]

Station	First quarter		Second quarter		Third quarter		Fourth quarter		Yearly average	
	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**	No. of samples	Average**
Tulsa, Okla.	5	10.2	8	5.4	4	0.6	2	0.1	19	(***)
Houston, Tex.	6	9.1	6	6.8	7	0.4	5	0.1	24	4.1
Dallas, Tex.	6	10.7	3	15.0	4	0.2	2	0.1	15	(***)
San Antonio, Tex.	7	9.2	6	6.0	5	0.5	4	0.2	22	4.7
Beaumont, Tex.	5	10.5	6	7.7	5	0.5	6	0.1	22	4.6
Galveston, Tex.	6	9.7	6	5.4	5	0.4	6	0.1	23	4.1
Texas City, Tex.	6	11.6	6	8.2	6	0.5	6	0.1	23	4.8
Calhoun County, Tex.*	6	6.2	-	-	2	0.2	1	0.1	9	(***)
Denver, Colo.	5	9.3	7	5.0	6	0.4	6	0.1	24	3.5
Montezuma Co., Colo.	6	14.0	6	10.7	4	0.5	6	0.1	22	6.9
Boise, Idaho	6	8.6	7	6.2	6	1.0	7	0.3	26	3.9
Butte County, Idaho*	7	11.8	5	10.2	5	1.2	6	0.2	23	6.1
Helena, Mont.	6	6.0	6	4.5	6	1.1	7	0.1	25	2.8
Glacier Nat. Pk., Mont.*	7	7.9	6	6.0	6	0.9	7	0.1	26	3.7
Salt Lake City, Utah	6	9.6	6	9.0	7	1.2	7	0.2	26	4.7
Bryce Canyon Pk., Utah*	6	10.6	6	9.0	6	0.5	6	0.1	24	5.1
Cheyenne, Wyo.	6	13.4	7	4.7	6	0.9	7	0.1	26	4.6
Yellowstone Pk., Wyo.	6	10.8	7	7.6	6	0.8	2	0.2	21	5.8
Anchorage, Alaska	7	4.5	7	5.3	6	0.5	5		25	2.8
Pt. Woronzof, Alaska*	6	7.6	6	3.2	6	0.6	7	0.1	25	2.7
Phoenix, Ariz.	7	18.0	6	8.0	5	0.4	7	0.2	25	7.1
Maricopa Co., Ariz.*	-	-	5	4.3	4	0.4	6	0.3	15	(***)
Grand Canyon Pk., Ariz.	6	17.6	7	6.1	5	0.3	6	0.1	24	6.3
Los Angeles, Calif.	6	15.2	5	6.5	5	0.4	5	0.2	21	6.0
San Francisco, Calif.	7	8.3	6	5.2	7	0.4	6	0.1	26	3.6
Berkeley, Calif.	6	8.7	6	3.2	7	0.4	6	0.1	25	3.0
San Jose, Calif.	6	7.0	6	8.2	7	0.6	7	0.1	26	3.7
San Diego, Calif.	6	11.0	7	7.0	6	0.7	8	0.2	26	4.6
San Bernardino, Calif.	6	8.0	6	7.4	5	0.7	7	0.2	24	4.0
Glendale, Calif.	6	11.6	6	6.7	7	0.8	5	0.2	24	4.8
Humboldt Co., Calif.*	6	5.3	7	4.7	3	0.1	6	0.1	22	3.0
Honolulu, Hawaii	6	8.1	7	4.9	6	0.4	6		25	3.4
Ewa County, Hawaii*	6	7.3	7	4.4	6	0.4	8		26	3.0
Las Vegas, Nev.	4	8.3	6	9.5	3	0.6	5	0.2	18	(***)
White Pine Co., Nev.*	6	11.9	5	9.2	6	0.9	4	0.1	21	5.8
Portland, Oreg.	7	5.8	6	4.6	6	0.4	7	0.1	26	2.7
Curry Co., Oreg.*	7	4.0	6	4.0	6	0.1	5	0.1	24	2.2
Seattle, Wash.	5	4.9	5	5.9	2	0.6	3	0.1	15	(***)
Clallam Co., Wash.*	1	2.4	3	5.5	3	0.1	1		8	(***)

[1] picocurie=1 micromicrocurie.

*Nonurban Station.

**Blank in table indicates level below minimum detectable value of 0.1 pc/m^3.

***Number of samples collected too small and did not provide adequate yearly coverage. Therefore, valid annual average could not be computed.

361

SECTION III.—WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provisions of Section 4(c) of Public Law 660, which states that ". . .the Surgeon General shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. At present there are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained. Radioactivity determinations are made on single samples, taken weekly.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing, beta activity in most raw waters is generally approaching a level attributed to only natural beta activity. Natural beta activity can be two or three times the natural alpha activity based on the same nuclides being present. Some exceptions to this are seen, notably the data for the Columbia River and the Animas River. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than one week. Beginning with samples taken in January 1960, beta determinations were performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

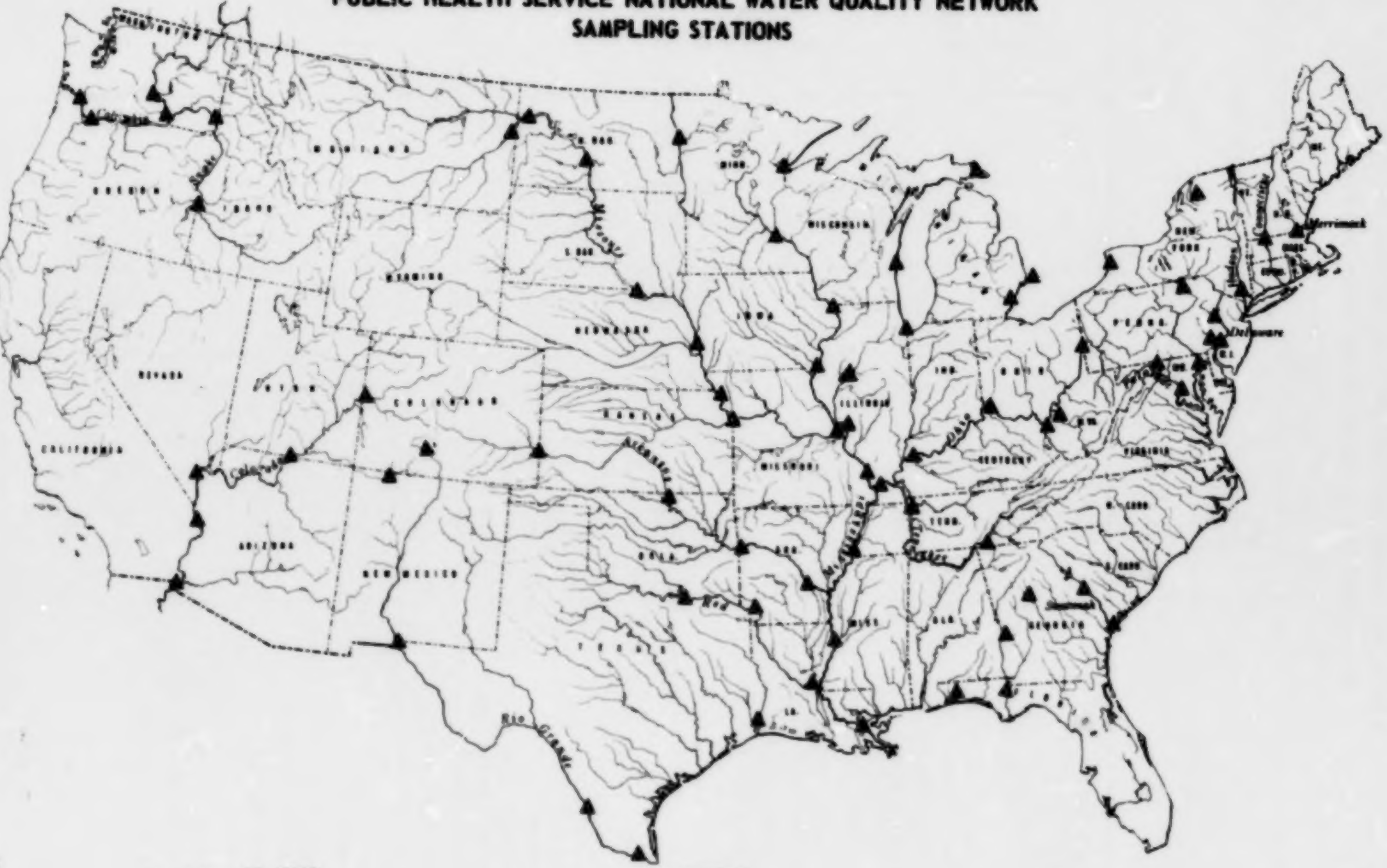
Strontium-90 data are reported as being the results of determinations on composite samples for a three-month period ending in the month shown.

Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959. Pages 167-169.

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK
SAMPLING STATIONS


MONTANA
OREGON
IDAHO
WYOMING
NEVADA
UTAH
COLORADO
CALIFORNIA
ARIZONA
NEW MEXICO
NEBRASKA
KANSAS
OKLA.
TEXAS
IOWA
WISCONSIN
ILLINOIS
MISSOURI
ARK.
MISS.
ALA.
GEORGIA
FLORIDA
KENTUCKY
VIRGINIA
PENNA.
OHIO
IND.
Columbia
Snake
Missouri
Colorado
Arkansas
Red
Rio Grande
Mississippi
Ohio
Potomac
Delaware
Hudson
Connecticut
Merrimack

As of June 30, 1960

FIGURE 3

TABLE VIII.—RADIOACTIVITY IN RAW SURFACE WATERS

Public Health Service National Water Quality Network

(micromicrocuries per liter)

Station	Quarter ending 3/31/60	Month of April 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ALSEA RIVER							
Alsea, Oreg.	0.1	0	0	0	0	0	0
ANIMAS RIVER							
Cedar Hill, N. Mex.	0.5	5	8	13	3	8	11
APALACHICOLA RIVER							
Chattahoochie, Fla.	-	0	0	0	0	0	0
ARKANSAS RIVER							
Coolidge, Kans.	1.2	0	0	0	-	-	-
Ponca City, Okla.	0.9	20	0	20	19	2	21
Pendleton Ferry, Ark.	0.8	27	5	32	8	0	8
CHATTAHOOCHIE RIVER							
Columbus, Ga.	0.5	0	0	0	1	0	1
COLORADO RIVER							
Loma, Colo.	0.1	0	0	0	14	1	15
Page, Ariz.	0.2	95	3	98	45	5	50
Hoover Dam, Ariz.-Nev.	0.7	0	<1	<1	<1	6	7
Parker Dam, Ariz.-Calif.	0.3	0	0	0	-	-	-
Yuma, Ariz.	0.3	0	0	0	<1	8	8
COLUMBIA RIVER							
Wenatchee, Wash.	0.4	1	0	1	0	1	1
Pasco, Wash.	0.6	-	-	-	-	-	-
Bonneville Dam, Oreg.	0.3	59	134	193	-	-	-
Clatskanie, Oreg.	0.1	20	58	78	0	0	0
DELAWARE RIVER							
Martin's Creek, Pa.	0.6	0	2	2	1	0	1
Philadelphia, Pa.	0.9	0	3	3	1	0	1
GREAT LAKES							
Gary, Ind.	0.5	-	-	-	-	-	-
Duluth, Minn.	0.2	1	0	1	0	0	0
Detroit, Mich.	0.3	0	0	0	0	0	0
Buffalo, N. Y.	0.9	0	1	1	0	0	0
HUDSON RIVER							
Poughkeepsie, N. Y.	1.7	<1	2	3	1	0	1
ILLINOIS RIVER							
Peoria, Ill.	-	4	2	6	1	<1	2
KANAWHA RIVER							
Winfield Dam, W. Va.	0.2	0	1	1	0	0	0
MERRIMACK RIVER							
Lowell, Mass.	0.5	-	-	-	-	-	-
MISSISSIPPI RIVER							
Red Wing, Minn.	0.7	2	8	10	1	0	1
Dubuque, Iowa	1.4	-	-	-	-	-	-
Burlington, Iowa	1.0	-	-	-	-	-	-

TABLE VIII.—RADIOACTIVITY IN RAW SURFACE WATERS—Con.

Public Health Service National Water Quality Network

(micromicrocuries per liter)

Station	Quarter ending 3/31/60	Month of April 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
MISSISSIPPI RIVER—Con.							
East St. Louis, Ill.	0.5	8	2	10	3	1	4
Cape Girardeau, Mo.	0.4	10	3	13	10	1	11
West Memphis, Ark.	1.3	11	0	11	7	2	9
Delta, La.	1.0	-	-	-	-	-	-
New Orleans, La.	0.9	19	0	19	-	-	-
MISSOURI RIVER							
Bismarck, N. Dak.	0.5	28	12	40	1	0	1
Yankton, S. Dak.	1.7	-	-	-	-	-	-
Omaha, Nebr.	0.4	46	10	56	16	4	20
St. Joseph, Mo.	0.9	18	5	23	9	8	17
Kansas City, Kans.	0.5	30	7	37	17	2	19
St. Louis, Mo.	0.9	9	7	16	-	-	-
OHIO RIVER							
East Liverpool, Ohio	0.5	0	<1	<1	1	0	1
Huntington, W. Va.	0.2	0	0	0	1	1	2
Cincinnati, Ohio	0.4	0	9	9	2	1	3
Evansville, Ind.	0.7	-	-	-	-	-	-
Cairo, Ill.	0.6	0	0	0	1	1	2
POTOMAC RIVER							
Williamsport, Md.	0.3	4	0	4	2	0	2
Great Falls, Md.	0.6	6	14	20	2	0	2
RED RIVER							
Denison, Tex.	1.4	0	30	30	3	2	5
Index, Ark.	0.7	0	4	4	1	0	1
Alexandria, La.	1.3	8	2	10	4	1	5
RIO GRANDE RIVER							
Laredo, Tex.	0.1	-	-	-	-	-	-
Brownsville, Tex.	0.6	0	0	0	0	0	0
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.3	0	0	0	0	0	0
SCHUYLKILL RIVER							
Philadelphia, Pa.	0.5	30	0	30	3	0	3
SAVANNAH RIVER							
Port Wentworth, Ga.	0.2	<1	11	11	2	<1	2
SNAKE RIVER							
Wawawai, Wash.	0.3	0	32	32	0	0	0
Weiser, Idaho	-	0	0	0	0	2	2
SUSQUEHANNA RIVER							
Sayre, Pa.	-	0	<1	<1	0	0	0
TENNESSEE RIVER							
Chattanooga, Tenn.	0.4	0	127	127	0	0	0
YELLOWSTONE RIVER							
Sidney, Mont.	1.2	17	12	29	0	0	0

25<

RADIOACTIVITY OF SURFACE WATERS IN THE UNITED STATES

(October 1, 1958-March 31, 1960)

L. R. Setter and S. L. Baker

Robert A. Taft Sanitary Engineering Center
Public Health Service

Measurements of radioactivity in surface waters gathered in the National Water Quality Network of Public Health Service were started in 1957. The radioactivity data for the 1958 water year ending September 30, 1958, was previously summarized.[1] This report summarizes the data for the succeeding period ending March 31, 1960. During this time, the number of regular stations in the Network has increased from 44 to 56, excluding some which no longer submit samples.

Beginning in October 1958, a part of each weekly sample on some stations was composited into a three-month sample for measurement of strontium-90. Since January 1959, the weekly samples at all stations have been similarly composited for Sr^{90} tests.

Tests of gross alpha activity were reduced to one sample per month when neither the suspended solids nor filtrate solids showed alpha activity of no significance over the 95 percent confidence level of counting.

Beta Activity of Surface Waters

Weekly gross beta activity tests of both suspended solids and membrane filtrate solids were continued through the 1959 water year beginning October 1, 1958, but beginning in October 1, 1959, the weekly samples of most stations were composited into semimonthly samples for gross beta tests of suspended and filtrate fractions. Continued weekly tests are made on the alpha activities of Colorado River stations, and beta activities of stations on the Columbia, Tennessee, and Savannah Rivers.

The beta radioactivities fluctuated widely from week to week and from station to station on a given stream, particularly with respect to "suspended" activity. Usually a high "suspended" activity reflected a somewhat greater dissolved (filtrate) activity. Although a monthly summary of results would indicate more clearly the rapid decrease in surface water beta activity in the late spring of 1959, a three-month summary has been selected to show average concentrations of gross beta activities and strontium-90 concentrations for drainage areas. The results in picocuries (pc = 1 $\mu\mu c = 10^{-12}$ curies) per liter are presented in Table 1 for 21 drainage areas or stations. The individual stations of Poughkeepsie on the Hudson River, Chattanooga on the Tennessee River and the four stations on the Columbia River were not included in averages of nearby general areas since they seemed to be significantly different. The stations on the Missouri and Mississippi Rivers were grouped to show possible effects of impoundment (in the central Missouri River and Central Mississippi) and major tributary flow or changing water quality.

In making an individual test,[2] a volume (usually 250-500 ml) of sample was taken following a conductivity test such that the dissolved (filtrate) solids would weigh between 100 and 200 mg. If the suspended solids of the sample exceeded 200 mg, they were distributed over 20 cm^2 of counting dish area or a smaller volume of sample was filtered. Under these practical criteria of sample preparation, the counting error for dissolved beta activities at the 95% confidence level was: (a) usually less than 8 pc/1 for stations on the Great Lakes and rivers of North Atlantic coast (including Poughkeepsie), Savannah, Chattahoochee, Tennessee, Alsea, Snake, and Columbia; (b) usually more than 8, but less than 20, for stations on Ohio, Mississippi and Missouri Rivers; and (c) usually more than 20 and less than 50 for stations on the Arkansas, Colorado, Red, and Rio Grande Rivers. The counting error of the suspended beta activity is about 8 pc/1 or higher as the suspended solids increase. For a 250 ml sample and a suspended solids of 400 ppm, the suspended beta error is 22 pc/1. The error of the strontium-90 determination varied from about 0.3 pc/1 in early 1959 to about 0.05 pc/1 in 1960.

The results in Table 1 are presented as bar graphs for each drainage area in Figures 1-4 inclusive. The Sr^{90} in one bar graph and the dissolved and total beta in another are shown for the 4 quarters of the 1959 water year and the first 2 quarters of the 1960 water year. The difference between the total and dissolved activity is the suspended (dotted) fraction. The average activity for the 1958 water year[1] is also shown for background information.

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[1] Setter, L. R., Regnier, J. E., and Diephaus, E. A., "Radioactivity of Surface Waters in the United States," JAWWA 51, 1377 (1959).

[2] Setter, L. R.; Hagee, G. R.; Straub, C. P., "Analysis of Radioactivity in Surface Waters--Practical Laboratory Methods." ASTM Bul. No. 227:35 (1958).

A review of the bar graphs for each drainage area shows peak concentrations of dissolved and total beta and strontium-90 occurred sometimes in the second (JFM) but usually in the third (AMJ) quarters of the 1959 water year for all drainage areas except the Hudson, Tennessee and Columbia rivers. Since the Spring of 1959, the concentration of dissolved and total beta diminished sharply and by the first quarter (Oct.-Nov.-Dec. 1959) of the 1960 water year the concentrations were frequently less than the counting error at the 95% confidence level.

The Hudson, Tennessee and Columbia rivers reflect the presence of radioactive liquid wastes. In the case of the Poughkeepsie station on the Hudson River the high January-February-March 1959 total beta and Sr^{90} may be due to a combination of industrial wastes and fallout of nuclear bomb debris. The continued pattern of Sr^{90} activity in excess of 1 pc/1 for the last two quarters of this report is indicative of pollution contributed by sources other than fallout.* The general relationship between gross beta and Sr^{90} in Tennessee River water is definitely not characteristic of pollution from fallout because the low and fluctuating beta was coupled with relatively high Sr^{90} values of 3.8 to 4.8 pc/1. The low Sr^{90} content in the 2nd quarter of the 1960 water year is more characteristic of fallout, while the high total and dissolved beta during this period is not characteristic of fallout.

The Columbia River samples at Pasco, Bonneville and Clatskanie reflect radioactivity from operations at Richland, Washington. Since much of the radioactivity is of relatively short half-life; and since the activity was first counted one-to-three weeks after sample collection, the average decay rate for each of the three downstream stations (see Table 2) was used to correct the observed activity to activity extrapolated to date of sample collection. These results averaged over 3-month periods are presented in bar graphs (Figure 4).

The bar graphs show the magnitude and decrease of beta activity from Pasco downstream due to radioactive decay, stream dilution and other physical, chemical and biological factors of natural purification. During the 1959 water year the average total beta activity was 42.8, 779, 334, and 245 pc/1 at Wenatchee, Pasco, Bonneville, and Clatskanie, respectively.

The yearly average beta activity for the 1959 water year, ending September 30, 1959, is shown in Table 3. The table shows more clearly that the Alsea and Snake Rivers and Columbia River above Hanford are least radioactive with respect to both beta activity and strontium-90. The Great Lakes, and Missouri and Rio Grande Rivers are somewhat more radioactive with respect to strontium-90, while most of the remaining basins have similar activities except the water of the Tennessee and Hudson Rivers and the Columbia River below Hanford.

Alpha Activity of Surface Waters

The gross alpha activity of "suspended" and "filtrate" samples were measured weekly until repeated analysis showed an indistinguishable concentration (less than the counting error at the 95 percent confidence level). The samples for alpha measurement were then reduced to one each month. Only the samples from the Colorado River showed detectable alpha activity and weekly measurements were continued.

The counting error in the alpha filtrate determination usually is in the order of 5 to 10 pc/1 for all except saline waters such as the Arkansas and Red Rivers. The error of alpha in suspended solids may be similar to ten times the usual filtrate activity error, depending on the volume of sample taken and the turbidity of the water. Since the alpha concentration was indistinguishable from "background" for all but the Colorado River samples, only the latter results are summarized and presented in Table 4.

The samples from Boulder City, Parker Dam and Yuma are from impounded waters relatively free of suspended solids and suspended alpha activity, whereas the samples from the upstream stations, Loma and Page, occasionally contain considerable suspended solids and suspended activity. The latter is added to the dissolved (filtrate) activity to give the total alpha activity.

The average alpha activity at each of the stations during the 1959 water year ending September 30, 1959, are shown in the following table.

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*EDITOR'S NOTE: The guide for average daily intake of strontium-90 used by the Department of Health, Education, and Welfare is presently 33 micromicrocuries per liter or kilogram of total dietary intake averaged over a period of one year. There is no comparable single standard for gross beta activity because of the many different radionuclides that may be present. Radiochemical analyses are usually necessary to determine the kind and amount of these radionuclides present. Data on radionuclides analyses of samples collected in the environs of Atomic Energy Commission installations are contained in the Quarterly Environmental Monitoring Reports of the Atomic Energy Commission. These reports will be summarized and published in subsequent issues of Radiological Health Data. AEC results for samples taken upstream of the Poughkeepsie station do not reflect the high total beta values reported by this station. The summary of this data will appear in the December 1960 issue.

27<

Yearly Average Alpha Activity of Colorado River

Station	Number samples	Dissolved Alpha pc/1	Total Alpha pc/1
Loma, Colo.	29	7.7 ± 9.0	11.7 ± 10.0
Boulder City, Nev.	16	7.7 ± 5.1	8.4 ± 5.4
Parker Dam, Calif. ...	36	5.3 ± 5.6	5.7 ± 6.1
Yuma, Ariz.	32	6.6 ± 7.4	8.8 ± 8.0
Average............	113	6.6 ± 6.9	8.5 ± 7.6

Based on the yearly average, the downstream impounded waters have less dissolved and less suspended alpha activity than unimpounded water at Loma, Colo. This tendency is more evident for the January-February-March 1960 period where the unimpounded water (Loma and Page) had an average of 11.5 dissolved and 47 total alpha as compared to the Parker Dam-Yuma average of 6 dissolved and 6 total picocuries of alpha per liter.

The alpha activity is sufficiently high to warrant further improvement in methodology for a more precise measurement of gross alpha or, better yet, occasional alpha radionuclide tests and the development of a method for a more precise measurement of the predominant and significant radioelements.

28<

TABLE I.—RADIOACTIVITY OF SURFACE WATER SAMPLES

Drainage area	Quarter	No. of samples	Beta activity		Sr^{90} pc/l	Sr^{90}* ratio
			Diss. pc/l	Total pc/l		
GREAT LAKES, including Buffalo, N.Y.; Detroit, Mich.; Sault St. Marie, Mich.; Gary, Ind.; and Duluth, Minn.	OND'58	50	14	17	-	-
	JFM'59	47	19	23	0.8	3.5
	AMJ'59	49	26	33	0.7	2.1
	JAS'59	44	9	13	0.5	3.8
	OND'59	52	2.6	7.0	0.56	8.0
	JFM'60	55	2.8	3.6	0.44	12.2
N. ATLANTIC COAST RIVERS, including Merrimac River at Lowell, Mass.; Connecticut R. at Northfield, Mass.; Schuylkill R. at Philadelphia, Pa.; Delaware R. at Martins Creek and Philadelphia, Pa.; and Potomac R. at Hagerstown and Great Falls, Md.	OND'58	45	30.3	38.8	-	-
	JFM'59	41	31.5	75.5	1.55	2.1
	AMJ'59	54	41.4	59.0	1.50	2.5
	JAS'59	44	10.8	15.0	1.04	6.9
	OND'59	49	2.4	5.0	0.46	9.2
	JFM'60	62	0.3	2.2	0.57	25.9
HUDSON RIVER, at Poughkeepsie, L. N.Y.	OND'58	13	32	56	-	-
	JFM'59	12	62	112	4.5	4.0
	AMJ'59	14	46	71	1.1	1.5
	JAS'59	12	7	18	1.0	5.6
	OND'59	12	3	8	1.3	16.3
	JFM'60	12	2	2	1.7	-
SAVANNAH RIVER, at N. Augusta and Savannah, Ga.; and Chattahoochee River at Columbus, Ga.	OND'58	22	38.5	44	-	-
	JFM'59	24	16.5	40.5	1.0	2.5
	AMJ'59	23	21.5	51.0	2.35	4.6
	JAS'59	25	15.0	21.5	0.50	2.3
	OND'59	34	9.3	12.0	0.53	4.4
	JFM'60	23	3	5.0	0.35	7.0
TENNESSEE RIVER, at Chattanooga, Tenn.	OND'58	13	25	27	-	-
	JFM'59	13	27	46	4.7	10.2
	AMJ'59	13	57	88	4.8	5.5
	JAS'59	13	33	35	3.8	10.9
	OND'59	13	39	44	1.1	2.5
	JFM'60	13	97	112	0.4	0.4
OHIO RIVER, including E. Liverpool, Ohio; Huntington, W. Va.; Cincinnati, Ohio; Evansville, Ind.; and Cairo, Ill.	OND'58	67	42	48	-	-
	JFM'59	60	39	91	1.0	1.1
	AMJ'59	54	31	62	1.72	2.8
	JAS'59	48	14.6	18.6	1.26	6.8
	OND'59	49	4.3	9.3	0.70	7.5
	JFM'60	58	2.4	6.6	0.48	7.3
CENTRAL MISSISSIPPI RIVER, including Red Wing, Minn.; Dubuque, Iowa; and Burlington, Iowa.	OND'58	24	26.0	36.3	1.0	2.8
	JFM'59	35	45	77	1.17	1.5
	AMJ'59	30	164	249	1.73	0.7
	JAS'59	25	17	28.3	1.07	3.8
	OND'60	31	5.7	9.0	1.17	13.0
	JFM'60	29	5.7	6.7	1.03	15.4
LOWER MISSISSIPPI RIVER, including E. St. Louis, Ill.; Cape Girardeau, Mo.; W. Memphis, Ark.; Delta, La.; and New Orleans, La.	OND'58	62	31	50	1.0	2.0
	JFM'59	60	68	148	1.14	0.8
	AMJ'59	66	77	195	1.84	0.9
	JAS'59	56	15.6	34	1.2	3.5
	OND'59	63	6.0	18.4	0.82	4.5
	JFM'60	60	6.8	19	0.82	4.3

*Percent Sr^{90} of total.

369

29<

TABLE I.—RADIOACTIVITY OF SURFACE WATER SAMPLES—Con.

Drainage area	Quarter	No. of samples	Beta activity		Sr^{90} pc/l	Sr^{90}* ratio
			Diss. pc/l	Total pc/l		
UPPER MISSOURI RIVER, Yellowstone R. at Sidney, Montana; Missouri River at Williston, N. Dak.	OND'58	20	31.5	61	0.4	0.65
	JFM'59	22	47.5	89	1.2	1.3
	AMJ'59	21	51.5	158	1.65	1.0
	JAS'59	24	10.0	57	0.6	1.1
	OND'59	17	6.8	13.1	0.6	4.6
	JFM'60	14	1	7.0	1.2	17.1
CENTRAL MISSOURI RIVER, including Bismarck, N. Dak.; Yankton, S. Dak.; and Omaha, Nebr.	OND'58	38	26	35.7	-	-
	JFM'59	38	33.3	51.3	0.57	1.1
	AMJ'59	31	62.0	125.	1.93	1.5
	JAS'59	37	21.7	30.3	0.77	2.5
	OND'59	36	10.0	15.3	0.80	5.2
	JFM'60	37	5.3	7.7	0.87	11.3
LOWER MISSOURI RIVER, including St. Joseph, Mo.; Kansas City, Mo; and St. Louis, Mo.	OND'58	36	34.3	72.7	0.90	1.2
	JFM'59	39	68.0	178.	0.73	0.41
	AMJ'59	39	59.3	340.	1.20	0.4
	JAS'59	38	19.7	100.	0.47	0.5
	OND'59	35	9.0	25.3	0.57	2.3
	JFM'60	36	6.0	27.3	0.77	2.8
ARKANSAS RIVER, including Coolidge, Kans.; Ponca City, Okla.; Ft. Smith, Ark.; and Pendleton Ferry, Ark.	OND'58	19	60	77	-	-
	JFM'59	24	62	144	1.43	1.0
	AMJ'59	38	154	298	2.1	.7
	JAS'59	28	48	131	1.1	.8
	OND'59	39	9.3	47	0.70	1.5
	JFM'60	37	14.7	35	0.97	2.8
RED RIVER, including Denison, Tex.; Index, Ark.; Alexandria, La.	OND'58	24	26	34	-	-
	JFM'59	26	50	93	2.0	0.8
	AMJ'59	29	97	128	2.4	1.9
	JAS'59	34	18.7	32.3	0.67	2.1
	OND'59	34	6.7	15.0	1.47	9.8
	JFM'60	34	4.0	10.	1.13	11.3
RIO GRANDE RIVER, including El Paso,[a] Tex.; Laredo, Tex.; and Brownsville, Tex.	OND'58	15	40.	106	0.3	0.28
	JFM'59	16	36.	89	0.5	0.56
	AMJ'59	26	79.	100	1.1	1.1
	JAS'59	26	25.	156	0.25	0.16
	OND'59	20	7.4	28	0.5	1.8
	JFM'60	21	26.5	28.4	0.29	1.0
COLORADO RIVER, including Loma, Colo.; Page, Ariz.; Boulder City, Nev.; Parker Dam, Calif.; Yuma, Ariz.	OND'58	47	38	51	-	-
	JFM'59	45	48	76	1.56	2.1
	AMJ'59	48	61	147	1.54	1.1
	JAS'59	44	22	30	0.65	2.2
	OND'59	49	8.4	27.4	0.72	2.6
	JFM'60	60	11	41.4	0.32	0.8
ALSEA RIVER, at Alsea, Oreg.	OND'58	-	-	-	-	-
	JFM'59	8	14	20	0	0
	AMJ'59	11	20	26	0.2	.8
	JAS'59	10	9	13	0.2	1.5
	OND'59	11	1	2	0.2	10.0
	JFM'60	13	0	0	0.1	-

*Percent Sr^{90} of total.

370

TABLE I.—RADIOACTIVITY OF SURFACE WATER SAMPLES—Con.

Drainage area	Quarter	No. of samples	Beta activity Diss. pc/l	Beta activity Total pc/l	Sr^{90} pc/l	Sr^{90}* ratio
SNAKE RIVER, including Weiser,[a] Idaho and Wawawai, Wash.	OND'58	25	17	23	-	-
	JFM'59	26	27	50	0.45	0.9
	AMJ'59	23	42.5	69.5	0.65	0.9
	JAS'59	15	12	16	0.40	2.5
	OND'59	11	2	4	0.40	10.0
	JFM'60	13	3	3	0.3	10.0
COLUMBIA RIVER, at Wenatchee, Wash.	OND'58	12	12	14	-	
	JFM'59	12	58	71	0.6	0.85
	AMJ'59	12	30	38	0.8	2.1
	JAS'59	10	6	8	0.5	6.3
	OND'59	13	3	4	0.8	20.0
	JFM'60	13	2	2	0.4	20.0
COLUMBIA RIVER, at Pasco, Wash.	OND'58	9	1020	1125	-	
	JFM'59	13	950	1032	1.4	
	AMJ'59	12	365	440	1.2	
	JAS'59	9	460	517	1.0	
	OND'59	13	495	560	0.9	
	JFM'60	13	1115	1355	0.6	
COLUMBIA RIVER, at Bonneville, Oreg.	OND'58	12	296	327	0.9	
	JFM'59	13	387	487	0.9	
	AMJ'59	13	190	253	1.1	
	JAS'59	9	232	270	0.5	
	OND'59	8	344	374	1.0	
	JFM'60	6	376	433	0.3	
COLUMBIA RIVER, at Beaver Army Terminal	OND'58	12	141	217	-	
	JFM'59	13	198	292	0.7	
	AMJ'59	13	186	262	1.2	
	JAS'59	12	181	209	0.5	
	OND'59	10	195	222	0.5	
	JFM'60	13	240	286	0.1	

*Percent Sr^{90} of total.

[a] Inactive.

TABLE 2.—OBSERVED HALF-LIVES OF BETA ACTIVITY IN COLUMBIA RIVER

Station	Number of tests	Half-life days
Pasco	13	25.1
Bonneville	8	32.6
Clatskanie	11	30.0

TABLE 3.—YEARLY AVERAGE RADIOACTIVITY OF U.S. SURFACE WATERS

(1959 Water year ending September 30, 1959)

Drainage basin	Beta Activity		Sr^{90} ** pc/l
	Diss. pc/l	Total pc/l	
Great Lakes	17.0	21.5	0.67
North Atlantic Coastal Rivers *	28.5	47.1	1.37
Hudson River	38.9	84.3	2.53
Savannah and Chattahoochee Rivers	22.9	57.3	1.28
Tennessee River	35.5	49.0	4.43
Ohio River	31.7	54.9	1.33
Central Mississippi River	63.0	97.7	1.24
Lower Mississippi River	47.9	106.8	1.30
Upper Missouri River	35.1	91.3	0.96
Central Missouri River	35.8	60.6	0.82
Lower Missouri River	45.3	172.7	0.83
Arkansas River	81.0	165.0	1.16
Red River	47.9	71.8	1.69
Rio Grande River	45.0	112.8	0.54
Colorado River	42.3	76.0	1.25
Alsea River	11.0	15.3	0.20
Snake River	24.6	39.6	0.50
Columbia River:			
Wenatchee	26.5	42.8	0.63
Pasco	699.0	779.0	1.20
Bonneville	276.0	334.0	0.85
Clatskanie	177.0	245.0	0.80

*Excludes Hudson River.

**9-month average beginning January 1, 1959.

TABLE 4.—ALPHA ACTIVITY OF COLORADO RIVER WATER

Period	Station	No. of samples	Dissolved pc/1	Alpha E*	Total pc/1	Alpha E*
1959 water year: OND 1958	Loma, Colo.	3	2	-	2	-
	Boulder City, Nev.	3	10	-	10	-
	Parker Dam, Calif.	5	5	4	5	5
	Yuma, Ariz.	2	6	5	6	5
	Average	13	5.3	4.6	5.5	4.7
JFM 1959	Loma, Colo.	9	6	9	7	10
	Boulder City, Nev.	4	9	6	10	6
	Parker Dam, Calif.	8	6	6	6	6
	Yuma, Ariz.	7	5	6	5	6
	Average	28	6	7	6.6	7.3
AMJ 1959	Loma, Colo.	8	3	5	7	8
	Boulder City, Nev.	6	4	7	5	8
	Parker Dam, Calif.	12	4	6	4	8
	Yuma, Ariz.	11	10	10	5	6
	Average	37	5.5	7.2	8.0	8.8
JAS 1959	Loma, Colo.	9	16	12	24	13
	Boulder City, Nev.	3	8	5	8	5
	Parker Dam, Calif.	11	7	6	8	6
	Yuma, Ariz.	12	5	7	6	6
	Average	35	8.6	7.6	11.5	8.1
1960 water year: OND 1959	Loma, Colo.	8	9	8	22	13
	Page, Ariz.	5	11	7	36	11
	Boulder City, Nev.	13	8	5	8	5
	Parker Dam, Calif.	9	6	3	6	3
	Yuma, Ariz.	7	16	13	18	15
	Average	42	9.5	6.5	15.2	8.0
JFM 1960	Loma, Colo.	10	8	6	16	8
	Page, Ariz.	13	15	7	78	22
	Boulder City, Nev.	11	7	5	7	5
	Parker Dam, Calif.	13	6	5	6	5
	Yuma, Ariz.	11	6	6	6	6.3
	Average	58	8.4	5.8	22.6	8.6

*Counting error in pc/1 at the 95% confidence level.

Figure 1 RADIOACTIVITY OF SURFACE WATERS
Gross Beta Activity and Strontium - 90 Concentration
October 1, 1958 - March 31, 1960

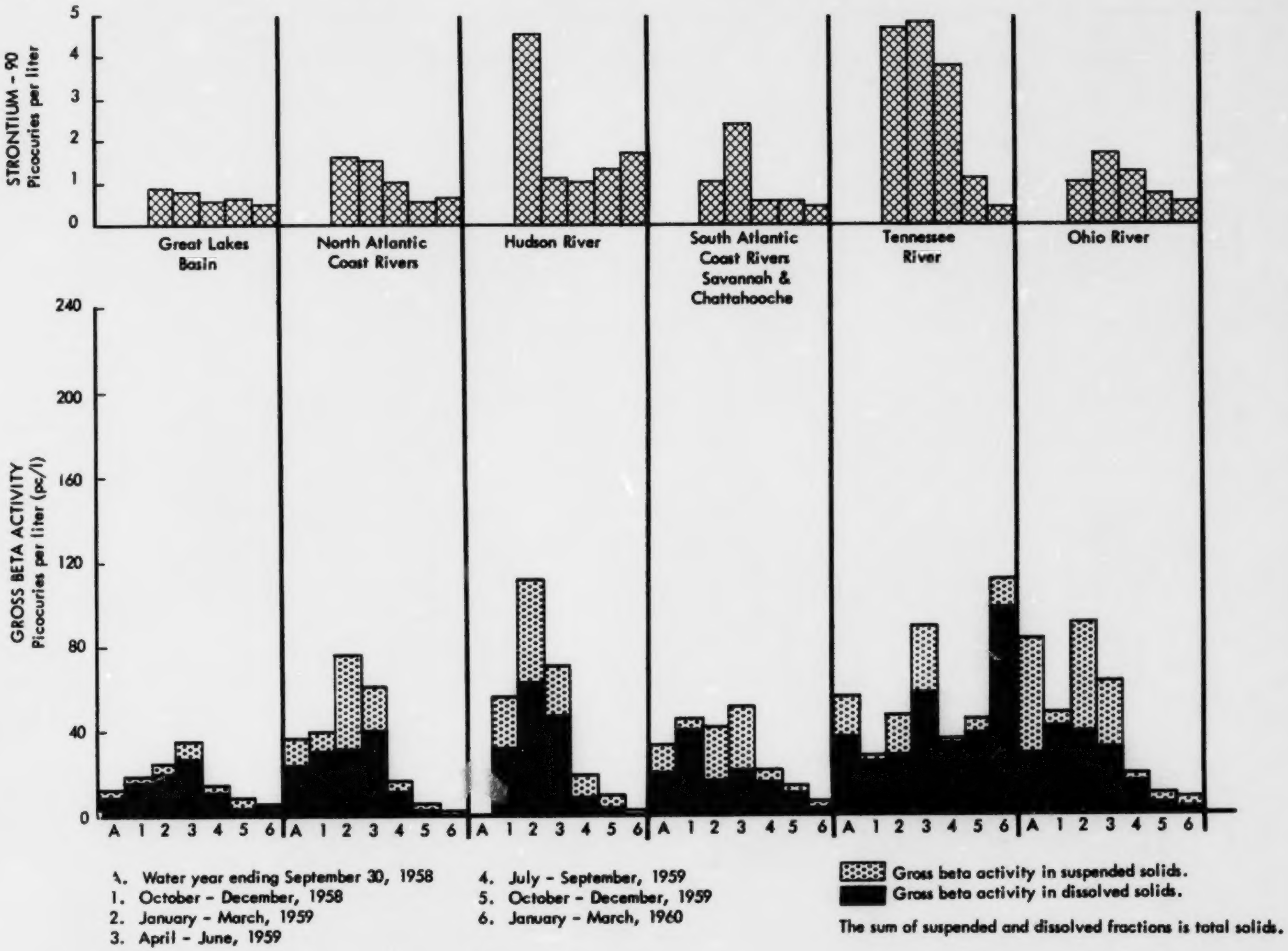


Figure 2 RADIOACTIVITY OF SURFACE WATERS
Gross Beta Activity and Strontium - 90 Concentration
October 1, 1958 - March 31, 1960

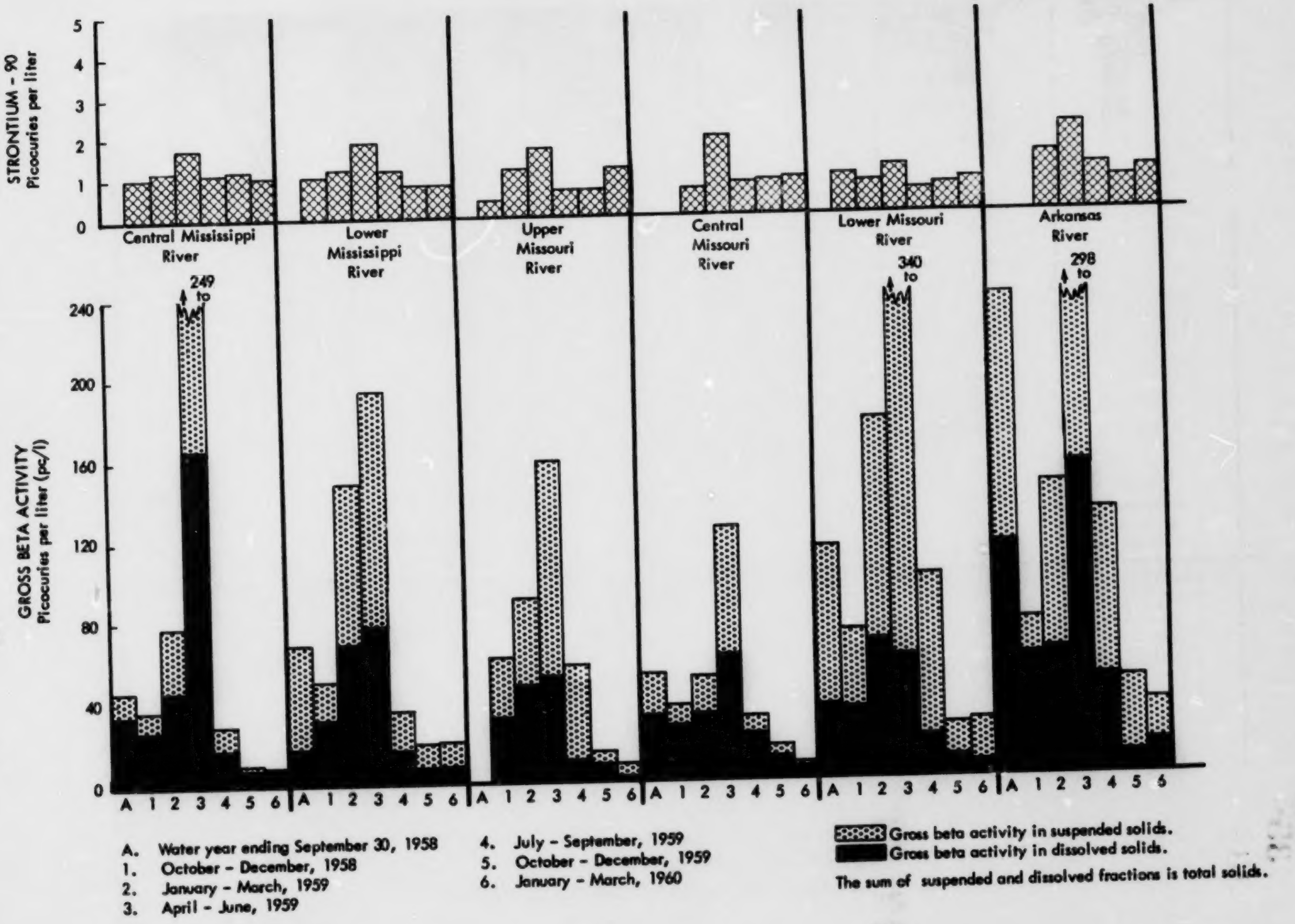


Figure 3 RADIOACTIVITY OF SURFACE WATERS
Gross Beta Activity and Strontium - 90 Concentration
October 1, 1958 - March 31, 1960

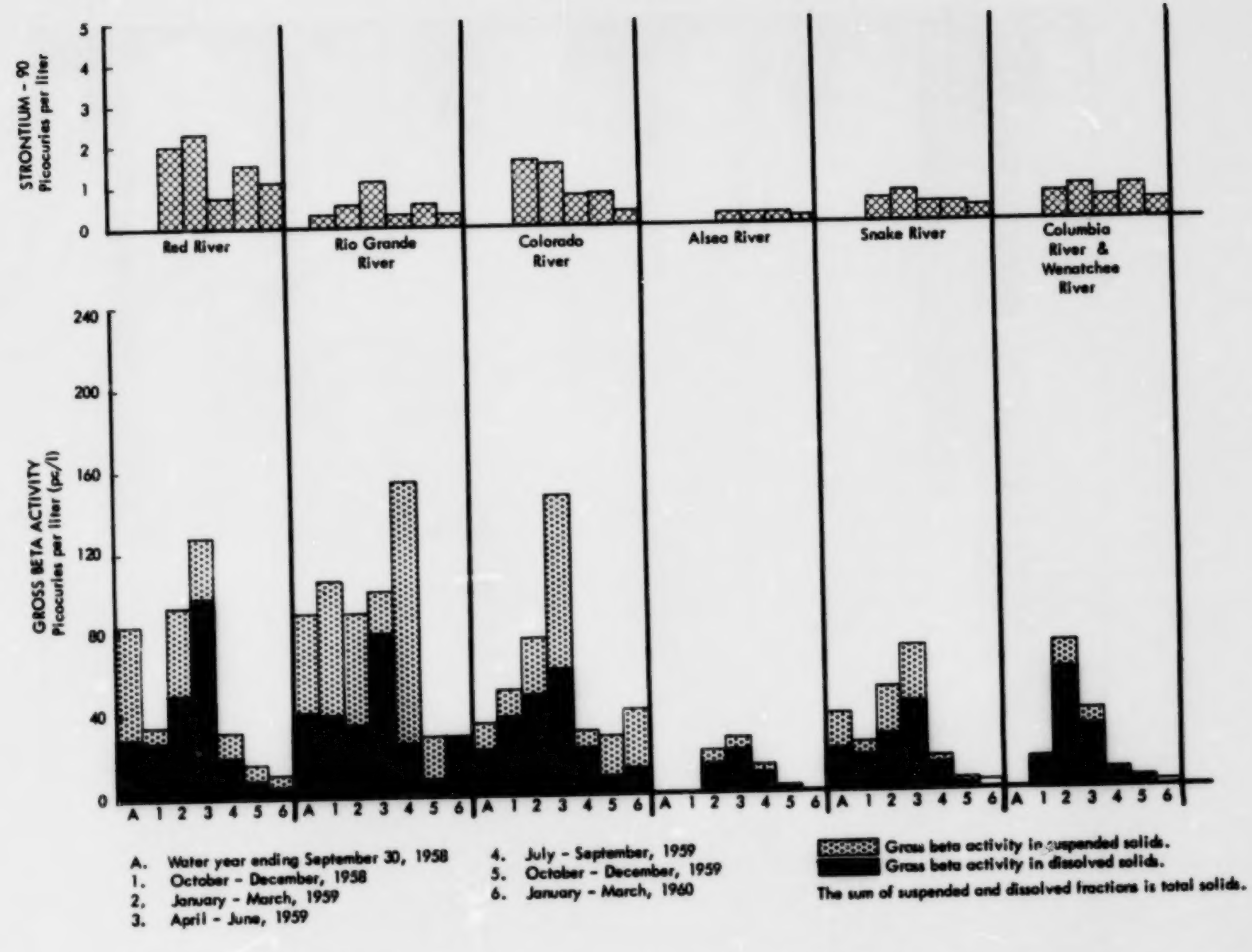
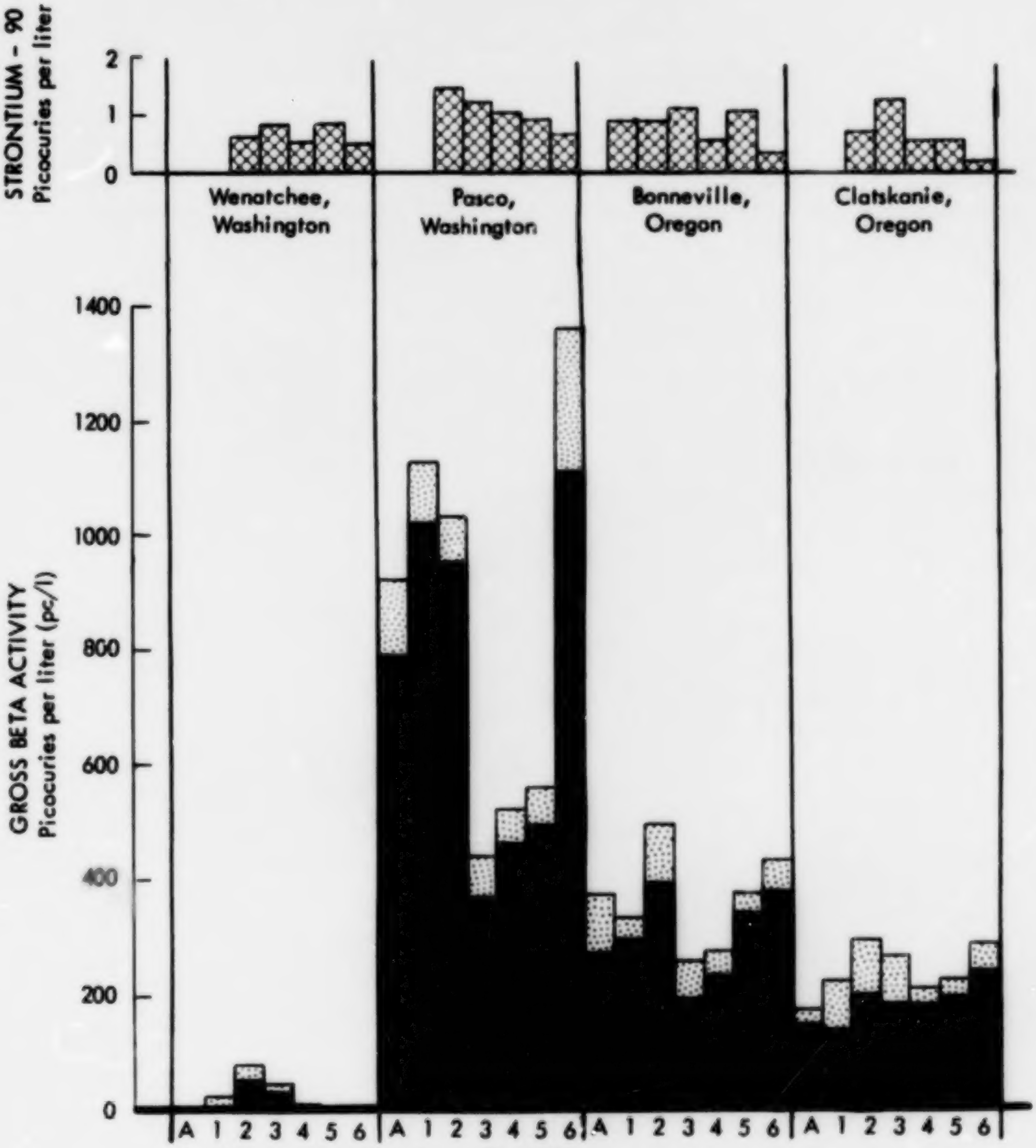


FIGURE 4 RADIOACTIVITY OF COLUMBIA RIVER WATER
Gross Beta Activity and Strontium - 90 Concentration
October 1, 1958 - March 31, 1960



A. Water year ending Sept. 30, 1958
1. October - December, 1958
2. January - March, 1959
3. April - June, 1959
4. July - September, 1959
5. October - December, 1959
6. January - March, 1960

▨ Gross Beta activity in suspended solids.
■ Gross Beta activity in dissolved solids.

The sum of suspended and dissolved fractions is total solids.

37<

SECTION IV.—OTHER DATA

EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variance anticipated due to differences in normal background and in instrument response characteristics.

TABLE IX.—EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

May 1960

Station Location	Average*	Station Location	Average*
	mr/hr		mr/hr
Alaska, Anchorage	0.01	Mississippi, Pascagoula	(**)
Alaska, Fairbanks	0.01	Missouri, Jefferson City	0.01
Alaska, Juneau	0.02	Montana, Helena	0.03
Arizona, Phoenix	0.01	New Jersey, Trenton	0.02
Arkansas, Little Rock	0.02	New Mexico, Santa Fe	0.04
California, Berkeley	0.01	New York, Albany	0.02
California, Los Angeles	0.01	North Carolina, Gastonia	0.02
Colorado, Denver	0.02	Ohio, Cincinnati	(**)
Connecticut, Hartford	0.01	Oklahoma, Oklahoma City	0.02
District of Columbia	0.02	Oklahoma, Ponca City	0.04
Florida, Jacksonville	0.01	Oregon, Portland	0.02
Georgia, Atlanta	0.02	Pennsylvania, Harrisburg	0.01
Hawaii, Honolulu	0.02	Rhode Island, Providence	0.02
Idaho, Boise	0.01	South Carolina, Columbia	0.02
Illinois, Springfield	0.01	South Dakota, Edgemont	0.02
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.02	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.01	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02
Minnesota, Minneapolis	0.01		

*Readings taken three feet above the ground.
**NO DATA RECEIVED.

378

DAILY INTAKE OF CALCIUM AND STRONTIUM-90

The following table presents an estimate of the amounts of strontium-90 and calcium that might be ingested or inhaled daily by man from environmental radiation sources such as air, water and food. These data were taken from studies conducted in 1958-59 on the above sources by the research group at the Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio, and is presented in detail in a paper entitled "Radionuclides in Food" by E. P. Straub, C. K. Murthy and J. E. Campbell.

In reporting such data it is the ultimate objective to relate these values on environmental radiation exposure to the maximum permissible guidelines set by the National Committee on Radiation Protection. Of the three parameters named above, food, air and water, food is the largest contributor with respect to daily strontium-90 intake.

TABLE X.—DAILY INTAKE OF CALCIUM AND STRONTIUM-90 FROM ENVIRONMENTAL SOURCES

Source	Estimated intake	Calcium		Strontium-90	
		Milligrams	Percent	μμc	Percent
Air	$20m^3$	-	-	0.8	5.2
Water	1,000 gm	60	5.2	0.8	5.2
Food					
Milk	500 gm	600	52.0	6.0	39.0
Dairy products, other	45 gm	145	12.5	1.8	11.7
Vegetables	370 gm	145	12.5	3.4	22.0
Meats, fish and eggs	370 gm	100	8.7	0.8	5.2
Cereal products	130 gm	60	5.2	1.4	9.1
Other	130 gm	45	3.9	0.4	2.6
Food, total	1,545 gm	1,095	94.8	13.8	89.6
GRAND TOTAL	....	1,155	100.0	15.4	100.0

379

39<

CONCENTRATION OF STRONTIUM-90 IN WHOLE WHEAT AND WHITE BREAD PURCHASED IN NEW YORK CITY IN 1958-60

The following data was tabulated from the Quarterly Summary Reports, HASL-69 (1 Oct. 1959) and HASL-88 (1 July 1960) published by the Health and Safety Laboratory, New York Operations Office, U. S. Atomic Energy Commission, New York, New York. Whole wheat bread made from whole wheat flour showed a higher concentration of strontium-90 (μμc per kilogram of sample) than white bread. This is to be expected since the white flour products resulting from continuous selective milling processes contain less of the outer wheat kernel fractions (bran, wheat germ, etc.) which are more heavily contaminated with the fallout fission product, strontium-90.

The daily intake of strontium-90 from whole wheat and white bread is rather small when one compares these concentrations to the actual amounts consumed. The amounts consumed are based on the average daily whole wheat and white bread per capita intakes. (See Radiological Health Data, August 1960, listing data from U. S. Department of Agriculture, Division of Household Economics Research, Washington, D.C.) Normally the highest intake would be from white bread since this is consumed in larger quantity than whole wheat bread despite the fact that the strontium-90 concentration in white bread is actually smaller than in whole wheat bread as shown in the table. Where whole wheat bread alone is consumed, the intake of strontium-90 would be higher for that individual than for an individual consuming a corresponding amount of white bread. The intake of strontium-90 from whole wheat bread is almost one percent of the intake in the entire diet. Values of 15 μμc in total daily diet have been reported elsewhere. Similarly the strontium-90 intake from white bread is about four percent of that in the total daily diet. The intake from whole wheat and white bread is roughly 25 percent of the total intake of strontium-90 in wheat milling products in the United States (see Table 3, page 38 in this report on influence of dietary patterns on calcium and strontium-90 intake in the United States and four geographical regions).

There does not appear to be any appreciable change in the strontium-90 levels in bread (whole wheat and white) from 1958 to 1960. However, it is noted that the composite whole wheat bread samples in January and February 1960 were slightly lower in terms of μμc per gram of calcium (45.5 μμc/gm of calcium for 1958 versus 29μμc/gm of calcium for February 1960).

TABLE XI.—STRONTIUM-90 AND CALCIUM IN BREAD PURCHASED IN NEW YORK CITY—(1958-1960)[1]

Sample date	Calcium gm/kg of sample	Strontium-90 μμc/gm calcium	Strontium-90 μμc/kg sample	Strontium-90 μμc/daily intake[2]
	Whole Wheat Bread			
Average 1958		45.5		
May 1959	0.97	61.0	59.0	0.2
May 1959	0.86	43.0	39.0	0.1
January 1960	0.80	28.0	22.0	.1
February 1960	0.76	29.0	22.0	.1
	White bread			
Average 1958		11.9		
May 1959	1.96	5.9	12.0	0.55
May 1959	1.22	10.0	12.0	0.55
January 1960	0.93	16.0	15.0	0.69
February 1960	0.89	11.0	9.5	0.44

[1] Data taken from Quarterly Summary Reports, HASL-69 and HASL-88.

[2] Calculated values from U. S. Department of Agriculture data on daily per capita consumption of 46.2 gm/day of white bread and 3.6 gm/day of whole wheat bread. (See Radiological Health Data, August 1960.)

ESTIMATED DAILY PER CAPITA INTAKE OF WHEAT MILLING PRODUCTS AND THE RELATIVE CONTRIBUTION OF STRONTIUM-90 FROM SUCH PRODUCTS TO THE TOTAL DIET[1]

Considerable interest has been demonstrated from time to time as to the significance of the contamination of single foods and total diet with radionuclides from fallout. Of special interest in technical and lay publications, is the concentration of the "bone seeker" strontium-90 in milk, certain leafy vegetables and grain products. The Health and Safety Laboratory (HASL), U. S. Atomic Energy Commission, New York Operations Office, New York, New York, in its Quarterly Summary Report on the Fallout Program, issued on April 1, 1960, drew attention to the levels of strontium-90 in wheat and milling products in nine states in 1958. The values for strontium-90 in micromicrocuries per kilogram of wheat milling products are shown in Table 1. The Honorable Arthur S. Flemming, Secretary of Health, Education, and Welfare, in a statement to the press (included in Radiological Health Data Report No. 4, Vol. 1, July 1960, page 5) reported on these same values and stated that the strontium-90 dietary intake of the population of the United States at the present time did not constitute a public health hazard warranting any regulatory action. Results from analyses by the Atomic Energy Commission Health and Safety Laboratory for the 1959 wheat crop are quite similar to those reported for the 1958 crop with respect to the whole wheat fraction. Other fractions are not yet reported upon.

An estimate of the average daily consumption of wheat products, dairy products and other foods totaling 2,200 grams was reported in the above mentioned statement published in April. From the values for dietary intakes of these foods, the strontium-90 values in terms of micromicrocuries of Sr-90 per day were calculated.

To evaluate more precisely the relative dietary contribution of Sr-90 in clear flour, whole wheat, bran and wheat germ, reference was made to data from the U. S. Department of Agriculture, Division of Household Economics Research for more definitive information on the daily intake of wheat milling products and derived food items (see August and September, 1960, and the current issue of Radiological Health Data —tables of "Food Consumption of Households in the United States." In the calculation of the daily per capita intake (in grams) of some 22 items classified as wheat milling products, it was also considered essential to determine the influence of geographic regions on the dietary pattern or total intake of each item. The estimated daily per capita consumption of wheat milling products in the United States and in the four regions—South, West, Northeast, and North Central—are shown in Table 2.

It is of interest to note that the South consumes more total wheat milling products than any other area, with the West and North Central regions being the second largest consumer and the Northeast population showing relatively lower intakes. While the people in the southern states have a somewhat higher intake of total wheat products than other regional groups, their daily intake is predominantly from clear or white flour products. The western states' population consumes the highest amounts of bran and whole wheat products, the outer coverings of the wheat kernel which contains potentially the highest concentration of strontium-90. The northeastern states reflect a somewhat lower daily intake of wheat products than any of the other regions, with the exception of whole wheat and bran which are much lower for the South.

The Health and Safety Laboratory has determined the range and the average concentration of calcium and strontium-90 on the 1958 crop in the wheat milling products from nine states. These values are reported in Table 1. Using these average values and the per capita intake data for the four geographical areas in the United States and the country as a whole, the daily strontium-90 intake from clear flour, whole wheat, wheat germ and bran was calculated and are shown in Table 3.

Paralleling the dietary intake values for the four wheat fractions, the northeast states showed a lower intake of strontium-90 than the other areas. The western states with an apparent higher intake of whole wheat and bran products reflect a slightly higher intake of strontium-90.

Admittedly, the differences in the estimated averages are not large in comparing one geographical region with another. However, the total difference in strontium-90 intake from wheat products in the Northeast and the West is about 75 percent of the computed daily strontium-90 intake value for water which ranges from 0.8 to 1.0 micromicrocuries per day[2,3]. The average values, of course, do not reflect the maximal deviations in radionuclide intake that could result by ingestion of milled products with the highest concentration. The high and low values for strontium-90 intakes are calculated and shown

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[1] By Dr. H. F. Kraybill, Chief Chemist, Division of Radiological Health, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D.C.

[2] Radiological Health Data Quarterly Report, Vol. 1, No. 4, page 6, July 1960, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D.C.

[3] Straub, C. P., Murthy, G. K. and J. E. Campbell, "Radionuclides in Foods"--paper presented at Annual Meeting of the Ohio Dietetic Association, Cincinnati, Ohio, May 6, 1960.

in Table 4. For wheat milling products showing the least contamination and the highest concentration of strontium-90, these tabular values reflect the extremes that are theoretically possible for ingestion of strontium-90. Since our food distribution system is such that populations would consume a mixture of low and high level strontium-90 in wheat products, it would be reasonable to assume that average values as shown in Table 3 would be the most useful reference data. It is interesting to note, however, that according to Table 4, there might be a low value of 0.3 micromicrocuries and a high value of 13.4 micromicrocuries for the daily intake of strontium-90 in patent or clear flour. With bran, the strontium-90 intake in micromicrocuries might range from a low of 0.1 to 1.62.

Wheat milling products in the form of bran, wheat germ or whole wheat represent the outer coatings of the kernel and, hence, contain the most contamination of strontium-90. The relative intakes of these fractions are quite small; and, hence, the ingestion of strontium-90 from this source is small. White or clear flour products from which much of strontium-90 contamination is removed in milling, contributes approximately 70 to 80 percent of the total strontium-90 in wheat products in the diet by virtue of the predominant amount of foods consumed made from this fraction of wheat.

The Department of Health, Education, and Welfare has adopted a guideline for average daily intake of strontium-90 at a level of 33 micromicrocuries per kilogram of total diet intake averaged over a one-year period. Assuming that the average person consumes approximately 2.2 kg (4.84 pounds) of food and water per day, then the total daily intake of strontium-90 would be 73 micromicrocuries. This guideline value of 33 $\mu\mu$c/kg of food and water is derived from the recent interim recommendation of the National Committee on Radiation Protection and Measurements (NCRP). This value applies to all groups within the population. The NCRP and the International Commission on Radiation Protection recommendations allow departures as much as 3 times the above average or 220 micromicrocuries.

The average intake values for wheat milling products in terms of strontium-90 according to Table 3 is four to six percent of the average daily intake guideline of 73 micromicrocuries. It would thus appear that the consumption of wheat products in the United States does not constitute any health risk at the present time necessitating regulatory action or any modification of the food or dietary. Further work on actual analyses of wheat milling products, total diets and other single foods will have to be accomplished to provide a more accurate assessment of the relative contributions of foods as an environmental exposure to radiation from fallout fission products.

TABLE 1.—CALCIUM AND STRONTIUM-90 VALUES IN WHEAT MILLING PRODUCTS IN NINE STATES—1958 CROP[1]

Wheat fraction	Weight kilograms	Calcium grams/kg material		Strontium—90 μμc/kg material		
		Range	Average	Low	High	Average
Input: Wheat	100	0.25 - 0.47	0.36	21	133	62
Output: Patent flour	58	0.08 - 0.23	0.14	3	42	12
Clear flour, 1st and 2nd[2]	14	0.07 - 0.38	0.24	6	86	28
Germ and shorts	17		0.87			133
Germs		0.52 - 1.66		50	191	
Shorts		0.42 - 1.67		28	665	
Bran	11	0.36 - 1.66	0.99	52	675	231
Output total	100					

[1] Data from Atomic Energy Commission Quarterly Summary Report, HASL-88, April 1960 and HASL-90, August 1960.

[2] Less refined than patent or high grade flour.

TABLE 2.—ESTIMATED DAILY PER CAPITA CONSUMPTION OF WHEAT PRODUCTS IN THE UNITED STATES AND FOUR GEOGRAPHICAL REGIONS OF THE UNITED STATES[1]

	U.S.A.	North-east	North Central	West	South
	Grams	Grams	Grams	Grams	Grams
1. Patent flour	130.3	108.3	128.2	125.0	155.5
2. Whole wheat (excluding bran in products)	9.5	11.0	11.8	14.5	5.5
3. Wheat germ	0.1	0.1	(*)	0.1	(*)
4. Bran (as cereal and in whole wheat items)	1.6	1.6	2.0	2.4	1.0
Total	141.5	121.0	142.0	142.0	162.0

*Less than 0.05 grams.

[1] Data calculated and tabulated by Mrs. C. LeBovit, Household Economics Research Division, U. S. Department of Agriculture and Dr. H. F. Kraybill, Chief Chemist, Division of Radiological Health, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C. These data are taken from Household Food Consumption Survey, Spring 1955.

43<

TABLE 3.—ESTIMATED AVERAGE OF CALCIUM AND STRONTIUM-90 VALUES FOR DAILY DIETARY INTAKES OF WHEAT MILLING PRODUCTS IN THE UNITED STATES AND FOUR GEOGRAPHICAL REGIONS[1]

Geographical region (USA)	Flour clear[2]	Whole wheat[3]	Germ	Bran	Total
	Calcium (milligrams)				
Total U.S.A.	49	5	(*)	2	56
Northeast	41	6	(*)	2	49
North Central	49	7	(*)	2	58
West	48	8	(*)	3	59
South	49	3	(*)	1	63
	Strontium-90 (micromicrocuries)				
Total U.S.A.	2.60	0.48	0.01	0.40	3.49
Northeast	2.20	0.55	0.01	0.40	3.16
North Central	2.60	0.60	(*)	0.50	3.70
West	2.50	0.73	0.01	0.60	3.84
South	3.10	0.28	(*)	0.20	3.58

[1] Calculated and tabulated by Dr. H. F. Kraybill, Chief Chemist, Division of Radiological Health, Public Health Service, Department of Health, Education and Welfare, Washington 25, D. C. Values calculated from tabular values shown on levels of intake of wheat milling products and assayed for calcium and strontium-90 shown in Tables 1 and 2.

[2] Patent flour value taken at intermediate value of 20 $\mu\mu$c/kg—Table 1.

[3] Whole wheat value (with bran excluded) taken at mid-value of 50 $\mu\mu$c/kg—Table 1.

[*] Insignificant contributions to the dietary at average level of intake.

TABLE 4.—ESTIMATED HIGH AND LOW CONCENTRATIONS OF STRONTIUM-90 IN DAILY DIETARY INTAKES OF WHEAT MILLING PRODUCTS IN THE UNITED STATES AND THE FOUR GEOGRAPHICAL REGIONS[1]

	Strontium-90 (micromicrocuries)			
	Patent or Clear Flour		Bran	
	High	Low	High	Low
Total U.S.A.	11.2	0.4	1.08	0.1
Northeast	9.3	0.3	1.08	0.1
North Central	11.1	0.4	1.35	0.1
West	10.7	0.3	1.62	0.1
South	13.4	0.4	0.70	0.1

[1] Calculations based on values shown in Table 1 (Strontium-90 Values in Wheat Milling Products) and Table 2 (Per Capita Consumption of Wheat Products in the U.S.A. and Four Geographical Regions of U.S.A.)

44<

ESTIMATES OF STRONTIUM-90 IN UNITED STATES DIETS

The significance of strontium-90 contribution to our foods and diets is reflected in the increasing interest shown by several organizations. Recently considerable interest has developed in the results of analysis of total diets and foods other than milk. In the following table there is summarized the principal organizations that have made these analyses and their calculation of the annual per capita intake of strontium-90.

TABLE XII.—ESTIMATES OF STRONTIUM-90 IN UNITED STATES DIETS[1]

Organization	Samples analyzed	Sampling		Method used to obtain annual intake	Calculated annual intake		Ratio $\frac{Sr^{90}(\mu\mu c)}{Ca\ (gm)}$
		Site	Date		$\mu\mu c\ Sr^{90}$	Grams of Ca	
HASL	Selected foods	N.Y.C.	Nov. 1959	Household diet survey[2]	6,534	370	17.7
HASL	Complete diets of lactating women for five days	Boston	May 1959	Extrapolated	9,490	562	16.9
PHS	Typical lunches	Cinn.	Nov. 1959	Lunch taken as typical meal (3 meals/day)	6,023	307	19.6
HASL	Complete diets of hospital personnel for six days	N.Y.C.	Dec. 1959	Extrapolated	4,960	399	12.4
HASL	Selected foods	N.Y.C.	Aug. 1959	A typical infant diet for the 1st year	6,475	462	14.0
Consumers Union[3]	Complete diets of teenagers for 2 weeks	24 cities	Nov. 1959	The average Sr^{90} from 24 U.S. cities (standard deviation = 2.4)			11.6
HASL	Selected foods	N.Y.C.	1958	Household diet survey[2]	4,650	370	12.6
PHS	Selected foods	Cinn.	1958	Random selection from cafeteria	3,157	257	12.3
FDA	Selected foods	U.S.	Feb.-Oct. 1959	Household diet survey 1955[2]	5,333	[2]420	12.7

[1] From Quarterly Summary Report, HASL-88, USAEC.

[2] U.S. Department of Agriculture Household Food Consumption Survey, 1955, Report No. 1.

[3] June 1960 Consumer Reports, page 289.

385

STRONTIUM-90 IN MILK AND AGRICULTURAL MATERIALS IN THE UNITED KINGDOM, 1958-59*

United Kingdom Agricultural Research Council

45< "This report (ARCRL-2) is the second of a series dealing with the contamination of human diet with strontium-90 from world-wide fallout. It records the levels in milk, the major source of strontium-90 in diet in the U.K., during the first half of 1959. The mean content of strontium-90 in the total diet cannot be assessed at six-monthly intervals because many of the foods other than milk which contribute strontium-90 to the diet are harvested only at one time of the year. A report on the levels in total diet during the whole of 1959 will be published in some months' time.

"This report also contains results of surveys of contamination in soil, herbage and animal bones in 1958, and results of experiments which assist the interpretation of these results.

"For the 12 months ending June 1959 the average level of strontium-90 in milk over the United Kingdom was 9.6 micromicrocuries per gram of calcium, i.e., an increase of about 40% over the 12 months' average for the period ending in December 1958. For the ten zones into which the United Kingdom is divided, the twelve-month mean values at the end of June 1959 range from 7.8 to 14.9 micromicrocuries of strontium-90 per gram of calcium; the higher values were from the wetter parts of the country.

"The results are also reported for a number of "special areas" which are being investigated to ascertain the highest levels of strontium-90 in milk which varying local conditions can produce. The highest mean value for the 12 months ending June 1959, 32 micromicrocuries of strontium-90 per gram of calcium, was from a small area in Mid Wales. This was nearly 20% higher than the mean value for 1958 in the same county.

"The proportion of strontium to calcium which is transferred from diet to human bone is only about one-quarter of the proportion of strontium to calcium in the diet. Thus the proportion of strontium-90 to calcium in new bone formed during 12 months ending June 1959 when the average level in milk was 9.6 micromicrocuries per gram of calcium would be approximately 2.5 micromicrocuries per gram of calcium in children who live on milk alone. In no large area of the country would this value be exceeded by more than about 50% but in the special area which gave the highest 12 month mean value in milk the corresponding value, assuming that only local cows' milk was taken, would be 8.

"In 1956 the Medical Research Council expressed the view that the level of strontium-90 in the bones of the general population should not exceed 100 micromicrocuries of strontium-90 per gram of calcium and that if the level showed signs of rising greatly beyond one-tenth of this value—i.e., 10 micromicrocuries of strontium-90 per gram of calcium—it would be desirable to give immediate consideration to the situation. The levels to be expected in bone from the highest levels hitherto recorded in milk do not reach this figure, let alone rise above it. The Medical Research Council is at present undertaking a comprehensive assessment of the significance of all evidence now available on the exposure of man to all sources of radiation, including the contamination of diet with fallout.

"The present results support the conclusion that the level of strontium in milk is determined mainly by the quantity of fallout deposited in the immediate past and not by the cumulative total in the soil. Therefore if weapon trials are not resumed and the rate of fallout consequently decreases no further increase in the levels of strontium-90 in milk is expected even though strontium-90 will continue to accumulate in the soil. The increase in the levels in milk during the period covered by this report is attributed to the high rate of fallout between November 1958 and May 1959 resulting from atomic weapon trials in Northern latitudes in the autumn of 1958. The 12 month mean value observed in milk for the period ending June 1959 may be regarded as the best estimate now available of the highest average level in milk likely to result from strontium-90 so far released. Such information as is available for samples collected after June 1959 shows that values have in fact decreased.

"The recent atomic tests in the Sahara, involving explosion in the Kiloton range, are not expected to have any significant effect on the level of world-wide fallout."

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*Press notice which accompanied Report ARCRL-2 published by the United Kingdom Agricultural Council.

ESTIMATE OF Sr^{90} IN DIET OF INFANTS

The following report and data furnish important information on the magnitude of radiation exposure of infants from radionuclides in food. Such data as these are quite essential in the assessment of environmental exposure to the growing infant, where strontium-90 deposition in the bones is more critical than the deposition in adults. The report is reprinted from the Atomic Energy Commission Health and Safety Laboratory, Quarterly Summary Report, HASL-88, July 1, 1960.

ESTIMATE OF STRONTIUM-90 IN THE DIET OF NEW YORK CITY INFANTS NURTURED ON COMMERCIALLY PROCESSED BABY FOODS AND MILK PURCHASED IN AUGUST 1959 AND JANUARY 1960.

Stanley Klein
Health and Safety Laboratory
Atomic Energy Commission

"An extensive variety of foods has been monitored for strontium-90 and the results have provided the basis for strontium-90 estimates of whole diets.[1-5] Most of these studies apply generally to all ages except infants up to about one year of age who consume specially processed foods. The approach has been to (1) determine an average individual intake of specific foods, (2) to calculate the total $\mu\mu c$ of strontium-90 and total grams of calcium in these foods, and (3) to obtain a Sr^{90}/Ca ratio for the whole diet by dividing the strontium-90 total by the calcium total. This technique has been adopted in this paper for estimating the strontium-90 levels in the diet of New York City infants[a] nurtured on commercially processed baby foods and milks from about the second half of 1959 through the first half of 1960.

Diet

"In order to estimate an infant's total consumption of baby foods, a daily diet was drawn up on the basis of literature findings [6,7] and with the help of pediatricians.[8] Since, in actuality, the diet of any particular infant may differ markedly from the one described here, a discussion of variations in the dietary Sr^{90}/Ca ratio will also follow.

"Until the infant is about one month of age, his daily diet consists of vitamin drops and canned formula milk (13 fl. oz.) diluted with an equal amount of water or less. At about two months, the infant is offered small but increasing quantities of solid foods which, by the time the infant is three or four months, amounts to one-half to three-fourth jar each of fruit, vegetables, and meat, three heaping tablespoons of cereal twice daily, and soup in addition to about one quart of milk. When the infant is about four months old, cow's milk (evaporated or fresh) replaces processed formula milk, but the quantity remains the same. One egg and three ounces of orange juice are added to the diet when the infant reaches his fifth month. This diet then prevails for the balance of the first year; towards its end, a transition begins from strained baby foods to either diced junior foods or fresh foods. However, both quantities and kinds remain the same.

Sample Selection

"Baby foods were purchased from retail stores in New York City on August 26, 1959 and analyzed for strontium-90 and calcium at the Health and Safety Laboratory. The sampling was repeated on January 28, 1960 in order to observe any marked variations since the original sampling. From the numerous variety of foods and brands available, samples were selected according to (1) the strontium-90 levels known to be present in the adult form of the food, (2) consumer popularity, which also decided, in part, the choice of brand, and (3) the contribution of the foods to the total calcium in an infant's diet. Consequently, cereals, vegetables, fruits, and milks were sampled, while meat, eggs, soups, and juices were not.[4] Meat, however, has been incorporated into this study by assuming that the strontium-90 and calcium levels in the baby food variety approximate the levels in the adult variety the values for which are available. The specific foods finally chosen for analysis were oatmeal cereal, rice cereal, and mixed cereal; spinach and mixed vegetables; peaches and pears and processed formula and evaporated milks. The results of the analyses are shown in Table 1a.[b]

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[a] In consideration of the production and distribution practices prevalent in the baby food industry, it is likely that the monitoring data for at least the non-milk foods can be related to a much larger area than just New York City--perhaps as large as an area as the entire East or Northeast Coast.

[b] A recent German report lists the results of strontium-90 analyses of German baby foods: Radioaktivitat und Strahlenbelastung, Der Bunderminister fur Atomkernenergie und Wasserwirtschaft. (Vierteljahr 1959) Tables 12a and 12d. A translation of these data is given in this HASL Quarterly, (HASL-88), Part II, page 184.

[1-8] See references on page 42.

387

Strontium-90 Estimate

"The daily intake of foods as prescribed in units of spoonfuls and jars was converted to gram equivalents by weighing out the food items from standard measuring spoons. The kilograms of foods consumed for the entire first year were then calculated and are shown in Table 2. Multipling these quantities of foods by the averaged strontium-90 and calcium content (from Table lb) and then summing gave the total amounts of these two substances in the diet. The ratio of these totals represents an overall dietary Sr^{90}/Ca ratio. This calculation appears in Table 3.

Discussion

"Table 3 shows that the Sr^{90}/Ca ratio for the whole diet is 14, while for the non-milk fraction alone it is 8, and for the milk fraction--which provides about 90% of the strontium-90 and 80% of the calcium--it is 15.[c] A range of Sr^{90}/Ca ratios was also obtained: only those values representing the highest and lowest Sr^{90}/Ca ratios within each diet category were used in determining a maximum and minimum total diet Sr^{90}/Ca ratio. The resulting maximum of 17 $\mu\mu$c Sr^{90}/gram Ca and minimum of 11 $\mu\mu$c Sr^{90}/gram Ca thus brackets the average 14 $\mu\mu$c Sr^{90}/gram Ca. These levels might be compared with an estimated 18 $\mu\mu$c Sr^{90}/gram Ca in the average adult diet for 1959.[d]

"Both the maximum and minimum milk fraction Sr^{90}/Ca ratios, as well as the average milk fraction ratio, primarily control the ratio in the total diet. The milk fraction ratio in the maximum calculation is 18 as compared with the non-milk fraction ratio of 13; the milk fraction ratio in the minimum calculation is 13 as compared with the non-milk fraction ratio of 3. (See summary of these data in Table 4.) Identical calculations have been made for diets of varying quantities and proportions of total milk to non-milk products. In all cases the Sr^{90}/Ca ratio in the milk fraction controlled the Sr^{90}/Ca ratio in the total diet. Thus, it may be concluded that because of the preponderance of milk in an infant's diet, the strontium-90 levels in the milk fraction of the diet dominate the overall dietary Sr^{90}/Ca ratio, and variation in these milk levels is more likely to have a greater influence on the total diet ratio than normal variations in the proportion of specific foods comprising the diet."

References

1. HASL-42, -51, -55, -65, -69, -77, and -84.
2. Harley, J. H., "Dietary Strontium-90 Estimates for the United States," HASL-65, p. 173 (May 29, 1959).
3. Russell, R. S., "Strontium-90 in Human Diet in the United Kingdom 1958," Agricultural Research Council, ARCRL 1, London: 1959.
4. Kulp, J. L., and Slakter, R., "Current Strontium-90 Level in Diet in United States," Science 128, 85-6 (1958).
5. "Strontium-90 in the Total Diet," Consumer Reports 25, 289-3 (June 1959).
6. Nelson, W. E., Textbook of Pediatrics, 7th Ed., W. B. Saunders Co., Philadelphia: 1959.
7. Spock, B., The Common Sense Book of Baby and Child Care. Duell, Sloan and Pearce, New York: 1957.
8. Dr. E. Feldman in particular offered many diet suggestions.

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[c] The dietary Sr^{90}/Ca ratio for the August 1959 sampling data alone is 14, for the milk fraction 16 and for the non-milk fraction 7. The similarity of these Sr^{90}/Ca diet levels with those above provides one justification for combining the August 1959 and January 1960 data for the purpose of this study.

[d] Personal communication with Dr. J. H. Harley.

TABLE 1a.--STRONTIUM-90 LEVELS IN BABY FOODS

Type of food	gm Ca per kg original material		$\mu\mu$c Sr^{90} per kg original material		$\mu\mu$c Sr^{90} per gm Ca	
	Purchase date		Purchase date		Purchase date	
	August 1959	January 1960	August 1959	January 1960	August 1959	January 1960
Precooked cereals:						
Oatmeal (Brand A)	7.72	7.39	19.5 ± 3.7	22.7 ± 7.2	2.53 ± 0.49	3.10 ± 0.99
(Brand B)		8.32		29.0 ± 11.9		3.12 ± 1.03
Mixed	8.17	9.03	37.3 ± 4.7	24.9 ± 8.1	4.57 ± 0.57	2.78 ± 0.90
Rice	9.02		5.96 ± 3.08		0.66 ± 0.34	
Strained vegetables:						
Creamed spinach	0.79		31.0 ± 1.7		39.4 ± 2.1	
Mixed	0.30	0.33	4.59 ± 0.80	8.10 ± 0.81	15.8 ± 2.8	24.5 ± 2.5
Fruits:						
Peaches		0.13		3.04 ± 0.96		22.9 ± 7.3
Pears		0.18		5.33 ± 0.36		29.4 ± 2.0
Milks:						
Formula (Brand C)	1.75	2.03	39.1 ± 1.0	48.2 ± 2.0	22.4 ± 0.6	23.8 ± 1.0
(Brand D)	1.25	1.20	18.7 ± 0.6	43.0 ± 0.8	14.9 ± 0.5	35.7 ± 0.7
Evaporated (Brand E)	2.34	2.44	34.9 ± 0.9	31.1 ± 1.2	14.9 ± 0.4	12.7 ± 0.5
(Brand F)		2.43		33.9 ± 1.3		13.9 ± 0.5

TABLE 1b.--AVERAGE STRONTIUM-90 LEVELS IN BABY FOODS BY TYPE

(August 1959 and January 1960 combined)

	gm Ca per kg original material	$\mu\mu$c Sr^{90} per kg original material	$\mu\mu$c Sr^{90} per gm Ca
Precooked cereals	8.28	23.2	2.73
Strained vegetables	0.47	14.6	31.1
Fruits	0.16	4.19	26.2
Milk: Formula	1.56	37.3	24.2
Evaporated	2.40	33.3	13.9

TABLE 2.—QUANTITIES OF BABY FOODS CONSUMED BY AN INFANT DURING HIS FIRST YEAR OF LIFE

Type of food	Age range	Daily consumption	Weight per unit (grams)	Daily consumption (grams)	Total consumption for age range (kilograms)
Cereals	3 mo.-1 yr.	6 heaping tablespoons	5	30	8
Vegetables	3 mo.-1 yr.	1/2-3/4 baby jar[1]	135	68-101	18.4-27.3 Avg. 22.9
Fruits	3 mo.-1 yr.	1/2-3/4 baby jar[1]	135	68-101	18.4-27.3 Avg. 22.9
Meats................	3 mo.-1 yr.	1/2-3/4 baby jar[2]	109	50-75	13.5-20.3 Avg. 16.9
Milks: Formula..	To 3 mo.	1 can (13 fl. oz.)	411	411	37
Evaporated	3 mo.- 1 yr.	1.23 can (16 fl. oz.)[3]	411	506	137

[1] 4.75 oz. jar. [2] 3.5 oz. jar. [3] After dilution amounts to about one quart.

TABLE 3.—STRONTIUM-90 IN THE DIET OF AN INFANT FOR HIS FIRST YEAR OF LIFE

Type of food	Quantities consumed kilograms	$\mu\mu$c Sr^{90}/kg original material	gm Ca/kg original material	Total consumed		$\mu\mu$c Sr^{90}/gmCa
				$\mu\mu$c Sr^{90}	gmCa	
Cereals	8	23.2	8.28	186	66	
Vegetables	23	14.6	0.47	336	11	
Fruits	23	4.19	0.16	96	4	
Meats	17	[1]1.2	[2]0.20	20	3	
Non-milk fraction of diet				638	84	7.6
Milks: Formula	37	37.3	1.56	1,380	58	
Evaporated	137	33.3	2.40	4,562	329	
Milk fraction of Diet				5,942	387	15.4
Combined milk and non-milk fractions				6,580	471	14.0

[1] Personal communication with Dr. J. H. Harley. [2] HASL-84, page 173, Table 8.

TABLE 4.—SUMMARY OF STRONTIUM-90 IN THE DIET OF AN INFANT FOR HIS FIRST YEAR OF LIFE

Calculation	$\mu\mu$c Sr^{90}/gm Ca		
	Non-milk fraction	Combined fractions	Milk fraction
Minimum	3	11	13
Average	8	14	15
Maximum	13	17	18

50<

FOOD CONSUMPTION OF HOUSEHOLDS IN THE UNITED STATES

Southern and Western Regions

As a necessary step in the evaluation of the radiological aspects of radioactivity in foods, there must be estimates of the kinds and amounts of food used. Estimates of food consumption in the United States as a whole, and of that in the Northeast and North Central Regions of the country appeared in the August and September 1960 issues of Radiological Health Data. Reproduced this month are the final two reports in this series prepared by the U. S. Department of Agriculture: "Food Consumption Per Person in Households in the South," and "Food Consumption Per Person in Households in the West."

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Household Economics Research Division
Washington 25, D. C.

Tables XIII and XIV, showing average "per person quantities" of foods used per week (in pounds) and per day (in grams), have been derived from data in "Household Food Consumption Survey," 1955, Reports No. 4 and No. 5, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price $1.00 per copy.

Averages are for foods used at home during a week in the spring, as brought into the household, and are based on all housekeeping households in the respective sections of the country. "Per person quantities" were computed by dividing "household quantities" by the "average household size" (3.52 in the South, and 3.15 in the West). "Average household size" was derived by dividing by 21 the total number of meals served from family food supplies during the survey week.

For some purposes, information on the consumption of those actually using a given food is more useful than averages based on all persons. An approximate but not precise figure can be computed from these data. Information was obtained in the survey on household use only—not on the individual member use of foods. An estimate of the average quantities of food per person using that food may be obtained by dividing the "quantities used per person per week," an average based on all households, by the "percentage of households using" shown in the second column. For example, the estimate of the average per-person use of commercially baked white bread per week (in Southern households using) is 1.18 pounds, derived by dividing 1.01 from the third column by 0.856 from the second column, (page 48). Such an estimate understates the value for those actually using the food, since it is not reasonable to assume that all members of all households reporting such use of food actually used some of the item. The understatement is probably small for such items as bread, sugar, etc., that in many households are likely to be eaten by every member, but it may be considerable for items such as tea, coffee, or baby foods that are less likely to be used by all members.

The estimate of the "quantity per person using" an item computed from this table will also be understated when the average size of household utilizing food is smaller than the average of all households. The average size of households using lamb and mutton for instance, is approximately 3.07 instead of 3.33 persons (all U. S.) and the average "per person per week" in households using is 0.84 pounds rather than the 0.77 pounds computed from the figures in this table (see August 1960 issue).

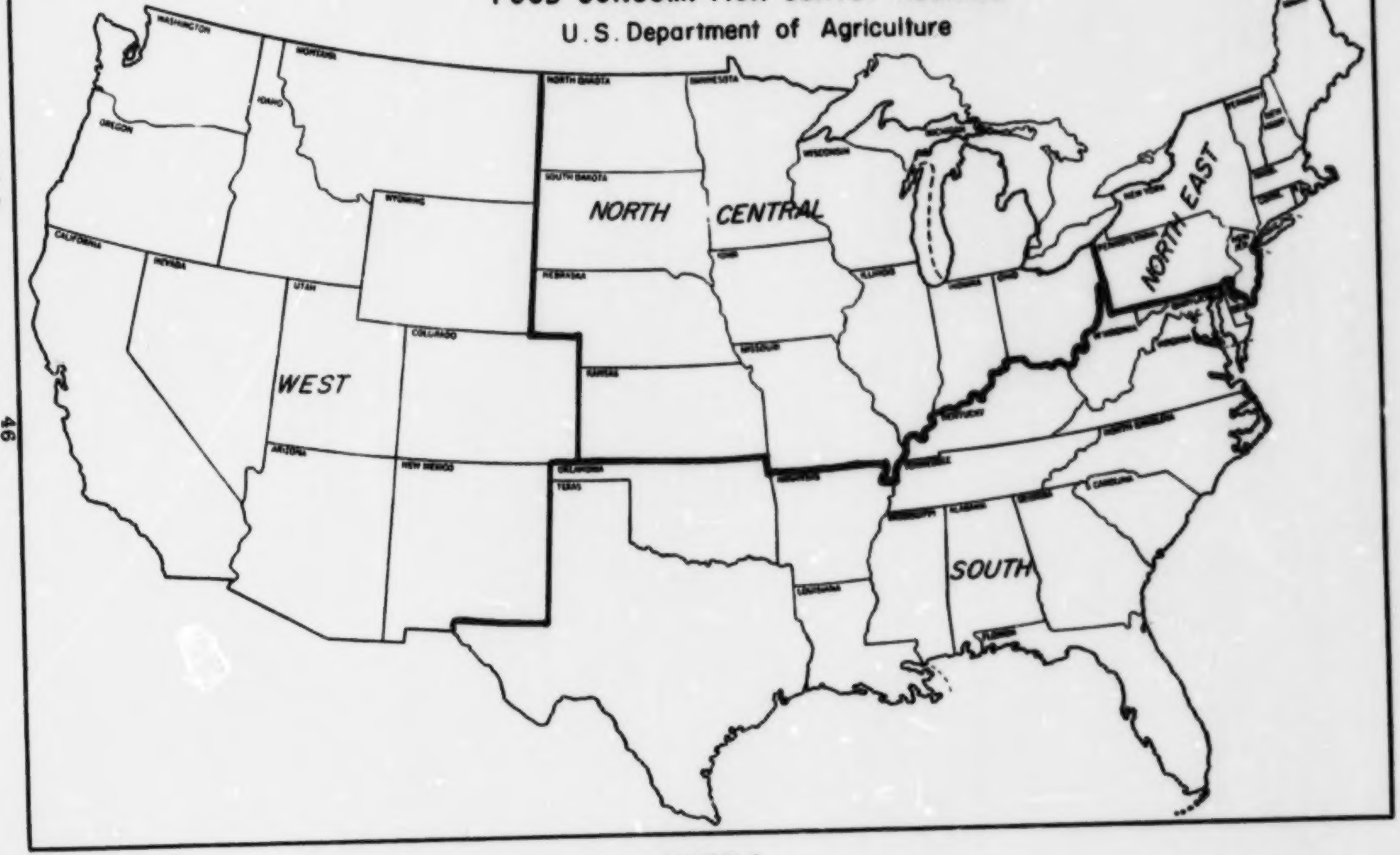
On the other hand, the estimated average computed from this table will be overstated when the average size of the households using is larger than that of all households. This is true, for example, for such items as ice cream (3.55 persons) and breakfast cereals (3.48 persons).

While estimates computed from these data will provide an indication of the importance of an item in the individual diet, they do not show the maximum likely to be used, such as would be shown by the percentage distribution using specified amounts per person. Also since the averages for those using the items are not additive, combinations of items cannot be easily estimated.

391

FOOD CONSUMPTION SURVEY REGIONS

U. S. Department of Agriculture


WEST
NORTH CENTRAL
NORTH EAST
SOUTH
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
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UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
NEW YORK

FIGURE 4

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	Quantity per person Per day (4)
	Percent	Pounds	Grams
Milk, cream, ice cream, cheese (fluid milk equivalent[1]	98.8	8.56	555
Fresh fluid milk, total	86.4	6.00	389
Whole	81.1	4.94	320
Buttermilk	38.4	.91	59
Skim	2.2	.07	4
Chocolate (commercial)	5.2	.07	5
Half and half, extra rich	1.1	(*)	(*)
Processed milk:			
Evaporated	51.9	.46	30
Condensed	3.0	.02	1
Dry, total	13.7	.04	2
Nonfat	9.3	.02	1
Whole	3.4	.01	1
Products, nonfat and whole[2]	1.4	(*)	(*)
Cream, total[3]	12.2	.03	2
Light	2.4	.01	1
Heavy, whipped, whip topping	9.8	.02	1
Ice cream, ice milk (commercial)[4]	48.2	.29	19
Cheese, total	64.0	.21	13
Cottage	16.3	.05	3
Nonprocessed, total[5]	25.4	.06	4
American-type	18.6	.05	3
Swiss	1.2	(*)	(*)
Cream	5.1	.01	1
Other	1.7	(*)	(*)
Processed, total[6]	39.7	.10	6
American, Swiss, cream, other	36.1	.09	6
Cheese spreads	6.1	.01	1
Fats and oils, total	99.5	1.01	65
Table fats, total	93.4	.32	21
Butter	42.7	.13	8
Margarine	65.2	.19	13
Shortening, total	86.8	.46	30
Lard[7]	43.8	.30	19
Other	47.4	.17	11
Salad and cooking oils	15.9	.05	3
Salad dressings (commercial), total	71.9	.17	11
Mayonnaise and mayonnaise-type	49.4	.09	6
French and french-type	8.8	.01	1
Other[8]	23.8	.07	4

*Less than 0.005 pounds or 0.5 grams.

[1] Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.

[2] Chiefly dry cocoa mixes.

[3] Includes small amounts of powdered cream, not shown separately.

[4] Includes frozen custard and frozen desserts with vegetable fats.

[5] Includes quantities of cheese for which respondent could not report whether or not processed.

[6] Includes small amounts of cheese food, not shown separately.

[7] Includes small amounts of chicken fat.

[8] Includes sandwich spreads.

393

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

53<

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Flour and other cereal products, total	98.8	2.82	182
Flour other than mixes, total	91.9	1.42	92
White	91.7	1.40	91
Other	1.5	.01	1
Prepared flour mixes, total	28.5	.13	8
Pancake	10.5	.03	2
Cake	13.7	.05	3
Biscuit, roll, muffin	7.2	.03	2
Other	5.8	.01	1
Breakfast cereals (excluding baby cereals), total	64.0	.19	13
Ready-to-eat, total	51.4	.12	8
Corn flakes	33.5	.06	4
Wheat, flaked, puffed, shredded	18.7	.04	2
Rice, flaked, puffed, etc.	6.7	.01	1
Other	9.0	.01	1
Hot, total[9]	27.3	.07	5
Rolled oats, oatmeal	24.7	.07	4
Wheat cereals	4.1	.01	1
Other cereals, total	86.3	1.08	70
Baby cereals	5.5	.01	(*)
Rice	40.0	.17	11
Cornmeals, grits, total	67.7	.79	51
Cornmeal	63.2	.70	45
Hominy grits	21.9	.09	6
Hominy (big)	4.2	.02	1
Macaroni, spaghetti, noodles	34.4	.08	5
Popcorn	4.7	.01	1
Other[10]	4.9	(*)	(*)
Bakery products, total	94.3	1.59	103
Bread, total	89.6	1.09	71
White[11]	85.6	1.01	65
Whole wheat	8.5	.05	3
Other	9.5	.04	2
Baked goods other than bread, total	76.4	.50	32
Crackers, total	50.3	.12	8
Sweet	8.3	.02	1
Not sweet	46.8	.11	7
Rolls, total	18.6	.06	4
Ready-to-eat	6.5	.02	1
Brown and serve	12.4	.04	3
Biscuits, muffins	12.4	.05	3
Cakes	21.1	.09	6
Pies	7.7	.04	3
Other[12]	39.5	.14	9

[9] Includes small amounts of other hot cereals not shown separately.
[10] Includes tapioca, cornstarch, barley, buckwheat grits.
[11] Practically all reported as enriched.
[12] Includes cookies, doughnuts, sweet buns, coffee cake, etc.

394

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	Quantity per person Per day (4)
	Percent	Pounds	Grams
Eggs	96.7	0.84	54
Meat, poultry, fish, total	99.1	3.70	240
Meat, total	98.7	2.58	167
Beef, total	77.3	.85	55
Steak, fresh, frozen, total	40.4	.27	17
Round	23.0	.13	9
Other	22.1	.13	9
Roast, fresh, frozen, total	22.8	.21	14
Rib	5.2	.05	3
Other	18.3	.17	11
Stewing, boiling, fresh, frozen	17.5	.10	6
Corned, chipped, dried	3.6	.01	(*)
Ground, fresh, frozen	49.8	.26	17
Canned (commercial)	5.0	.01	1
Veal, total[13]	7.1	.04	3
Roast, shoulder, fresh, frozen	.7	.01	(*)
Chops, cutlets, fresh, frozen	6.2	.03	2
Pork, total	94.6	1.26	82
Fresh, frozen, total	55.6	.44	29
Chops	31.8	.17	11
Ham	2.6	.02	1
Loin	3.7	.03	2
Sausage	28.8	.12	8
Other	13.3	.10	6
Cured, smoked, total	90.7	.82	53
Ham, raw, precooked	32.6	.26	17
Bacon	71.3	.32	20
Salt pork	32.6	.14	9
Other	16.9	.10	6
Canned (commercial)	1.4	.01	1
Lamb, mutton, total	3.0	.02	1
Chops, steak, fresh, frozen	1.3	.01	1
Roast, shoulder, leg, fresh, frozen	1.3	.01	1
Stewing, soup, ground, patties	.4	(*)	(*)
Variety meats and game, total	21.5	.10	6
Liver	17.0	.06	4
Other[14]	6.0	.03	2
Luncheon meats, total	62.5	.30	20
Frankfurters	35.5	.12	8
Other, total	46.6	.18	12
Canned	8.8	.03	2
Other	42.5	.15	10
Poultry, total[15]	62.8	.70	45
Chicken[16]	62.1	.67	43
Turkey[16]	1.3	.02	1

[13] Includes small amounts of other veal, not shown separately.

[14] Includes tongue, kidney, heart, tripe, etc.; game.

[15] Includes small amounts of other poultry, not shown separately.

[16] Chiefly fresh or frozen, only small amounts of canned reported.

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

55<

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)
	Percent	Pounds	Grams
Meat, poultry, fish—Con.			
Fish and shellfish, total	58.0	0.42	27
Fish, total[17]	54.1	.38	24
Canned (commercial), total	30.5	.08	5
Salmon	15.7	.05	3
Tuna	12.8	.02	1
Other[18]	5.5	.01	1
Fresh, frozen	34.2	.29	19
Shellfish, fresh, frozen, canned	9.9	.04	3
Sugar, sweets, total	98.9	1.45	94
Sugar, total	96.7	.95	62
White, total	96.6	.94	61
Granulated	96.5	.91	59
Confectioners, powdered	9.9	.03	2
Brown	7.1	.01	1
Sirups, molasses, honey, total	46.2	.22	14
Sirups, total	38.1	.18	11
Corn, cane	23.7	.11	7
Maple, sorghum, other[19]	15.7	.07	4
Molasses	5.7	.03	2
Honey	6.2	.01	1
Jellies, jam, total	60.7	.21	13
Jellies	41.4	.11	7
Jam, preserves, fruit butters, etc.	31.1	.10	7
Candies (commercial), total	31.1	.08	5
With nuts	11.7	.02	1
Without nuts	22.4	.06	4
Potatoes, sweetpotatoes, total	89.4	1.56	101
Fresh, total	88.3	1.53	99
White	87.1	1.43	93
Sweetpotatoes	11.9	.09	6
Frozen[20]	1.1	(*)	
Canned, dehydrated[21]	4.9	.02	1
Potato chips and sticks[22]	13.9	.02	1
Fresh vegetables, total[23]	97.4	2.85	185
Dark green and deep yellow, total[24]	63.0	.40	26
Dark green leafy, total	34.5	.25	16
Spinach	3.6	.02	1
Other	32.3	.24	15
Broccoli	.7	(*)	(*)
Carrots	33.0	.11	7
Peppers, green	19.9	.02	1

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[17] Includes small amounts of smoked, cured fish, not shown separately.
[18] May include small amount of ready-cooked fish, not canned.
[19] See page 53 for chocolate sirup.
[20] Chiefly french fried.
[21] Chiefly canned sweetpotatoes.
[22] Chiefly chips.
[23] Includes home canned and frozen vegetables that were brought into the home in fresh forms.
[24] Includes other dark green and deep yellow vegetables not shown separately.

396

56<

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	Quantity per person Per day (4)
	Percent	Pounds	Grams
Fresh vegetables—Con.			
Other green, total	86.8	1.19	77
Asparagus	2.8	.02	1
Beans, snap, wax	41.8	.32	21
Cabbage	47.8	.41	27
Lettuce	57.6	.25	16
Peas	13.0	.10	7
Other	15.3	.09	6
Tomatoes	61.0	.40	26
Other than tomatoes and green and deep yellow, total	87.6	.86	56
Celery	29.5	.07	4
Cucumbers	16.7	.06	4
Mature onions	58.9	.20	13
Green onions	30.1	.08	5
Other, total[25]	48.6	.45	29
Corn	24.3	.26	17
Fresh fruits, total[26]	84.1	2.33	151
Citrus, total[27]	60.0	.91	59
Grapefruit	17.9	.23	15
Lemons, limes[28]	37.6	.16	10
Oranges	32.9	.52	34
Other than citrus, total[29]	74.3	1.42	92
Apples	37.0	.34	22
Bananas	50.5	.40	26
Melons	10.6	.41	27
Rhubarb	1.7	.01	1
Strawberries	10.2	.07	5
Avocados	2.2	.01	(*)
Berries other than strawberries	7.0	.05	3
Cherries	1.8	.01	1
Peaches	9.4	.07	5
Other	5.9	.04	3
Commercially frozen fruits and vegetables	25.3	.11	7
Fruits[30]	7.0	.02	1
Vegetables other than potatoes, total	21.7	.09	6
Beans, lima	9.1	.02	1
Beans, snap, wax	1.5	(*)	(*)
Broccoli	5.6	.01	1
Peas	5.9	.01	1
Spinach	2.0	.01	(*)
Corn	2.4	.01	(*)
Other	8.7	.03	2

[25] Includes beets, cauliflower, turnips, rutabagas, and others not shown separately.

[26] Includes home canned and frozen fruits that were brought into the home in fresh form.

[27] Includes small amounts of tangerines and kumquats not shown separately.

[28] Chiefly lemons.

[29] Includes small amounts of figs and grapes not included in "Other."

[30] Chiefly strawberries.

397

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

57<

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Commercially canned fruits and vegetables, total	76.3	1.00	65
Fruits, except baby and junior foods, total	42.4	.30	20
Apples, applesauce	11.6	.05	3
Apricots	1.6	.01	1
Berries	2.5	.01	1
Cherries	4.9	.01	1
Peaches	20.1	.11	7
Pears	5.7	.03	2
Pineapple	14.0	.05	3
Plums, prunes	.5	(*)	(*)
Mixed fruit, fruit cocktail	6.2	.03	2
Other	1.6	.01	1
Baby, junior foods, incl. juices	6.9	.03	2
Vegetables, except baby and junior foods, total[31]	65.0	.64	42
Asparagus	5.2	.02	1
Baked beans, or other mature beans	8.0	.04	3
Beans, lima, green, immature	8.5	.03	2
Beans, snap, wax	15.0	.08	5
Beets	6.7	.02	1
Corn	26.8	.12	8
Peas, green, immature	28.1	.12	8
Tomatoes, total	23.2	.11	7
Pulp	18.2	.10	6
Puree, paste	7.8	.01	1
Other	20.4	.09	6
Baby, junior foods, incl. potatoes	4.9	.02	1
Fruit and vegetable juices, fresh, frozen, canned, powdered [32, 33]	43.1	.67	43
Canned citrus, total[32, 34]	18.3	.24	15
Orange	11.6	.15	10
Grapefruit	6.2	.07	4
Canned fruit other than citrus[32]	12.9	.11	7
Canned tomato and other vegetable juices[32, 35]	13.1	.11	7
Frozen, concentrated, total	11.9	.05	3
Orange	10.9	.05	3
Other	2.4	.01	(*)
Fresh (commercial)	2.0	.03	2
Dried fruits and vegetables, total[36]	57.5	.30	19
Dried fruit, total	17.4	.05	3
Prunes	8.8	.03	2
Raisins, currants	8.3	.01	1
Other	3.2	.01	1

[31] Includes small amount of mature peas not included in "Other."

[32] Single strength equivalent.

[33] Does not include baby or junior juices. See above.

[34] Includes orange and grapefruit blend and other citrus juices not shown separately.

[35] Includes both commercially and home-canned and frozen juices.

[36] Includes both commercially and home-dried fruits and vegetables.

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Dried fruits and vegetables—Con.			
Dry vegetables, total	49.1	0.25	16
Beans, total	44.7	.22	14
Lima	17.4	.07	4
Navy, pinto, kidney, other	32.3	.15	10
Peas, lentils, other	10.8	.03	2
Beverages:			
Coffee, total[37]	86.5	.20	13
Bean, ground	72.1	.19	12
Instant, powdered	16.3	.01	1
Substitute	2.7	(*)	(*)
Tea[38]	33.1	.03	2
Chocolate, cocoa, chocolate sirup, total	21.6	.02	1
Chocolate	4.1	.01	(*)
Cocoa	15.7	.01	1
Chocolate sirup	2.6	.01	1
Soft drinks, fruit ades, total	59.0	.90	58
Soft drinks, bottled and canned, total	53.9	.87	57
Cola-type	48.2	.73	47
Fruit flavored	7.1	.08	5
Other	6.9	.06	4
Powdered	8.1	.01	(*)
Fruit ades, total	3.7	.02	1
Frozen	1.8	.01	(*)
Other	2.0	.01	1
Miscellaneous foods:			
Nuts (shelled weight) and peanut butter, total	39.7	.07	5
Nuts (shelled weight), total	14.3	.02	1
Peanuts	5.0	.01	1
Other	9.6	.01	1
Peanut butter	31.0	.05	3
Soups, except canned baby soups, total	25.8	.11	7
Vegetable, total	15.8	.06	4
Condensed	13.9	.05	3
Other	2.1	.01	(*)
Meat, fish, grain, total	13.3	.05	3
Condensed	11.5	.04	3
Other	2.0	.01	(*)
Catsup, chili sauce, etc., total[39]	31.1	.06	4
Catsup	27.1	.04	3
Chili sauce	1.7	(*)	(*)
Barbecue sauce, etc.	4.9	.01	1
Tomato relishes	2.5	.01	(*)
Pickles, olives, relishes, total[39]	38.4	.12	8
Pickes	34.7	.10	7
Olives	6.4	.01	(*)
Relishes other than tomato	3.7	.01	(*)

[37] Includes small amounts of liquid concentrate coffee, not shown separately.

[38] Data refer to amounts bought during the 7-day survey period rather than the amounts used.

[39] Includes both commercial and homemade products.

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE SOUTHERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

59<

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Miscellaneous foods—Con.			
Puddings, pie fillings, miscellaneous sweets (commercial), total[40]	28.5	0.06	4
Puddings, pie fillings[41]	22.1	.03	2
Strained canned puddings (baby)	2.8	.01	(*)
Sherbets, ices	4.5	.02	1
Icing mix, fudge mix	2.3	.01	(*)
Other mixtures, prepared or partially prepared, total	27.8	.15	10
Mixtures other than baby, junior foods, total	25.2	.12	8
Without meat[42]	9.0	.05	3
With meat[43]	18.2	.08	5
Baby, junior foods, total	5.3	.02	1
Meat, mixtures with meat	5.0	.02	1
Without meat	1.5	(*)	(*)
Leavening agents, total[44]	24.6	.05	3
Yeast	5.2	(*)	(*)
Other[44]	20.5	.05	3
Seasonings:[44]			
Vinegar	10.1	.07	5
Salt	29.2	.14	9

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[40] Includes other miscellaneous sweets not shown separately.

[41] Chiefly dry, including plain gelatin.

[42] Includes spaghetti with tomato sauce, potato salad, cole slaw, macaroni and cheese dinners, chow mein and chop suey dinners, and others.

[43] Includes poultry and meat pies, spaghetti with meat balls, corned beef hash, chili con carne, ravioli, tamales, and others.

[44] Data refer to amount bought during a 7-day survey period rather than the amounts used.

400

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)
	Percent	Pounds	Grams
Milk, cream, ice cream, cheese (fluid milk equivalent[1])	99.6	10.42	675
Fresh fluid milk, total	94.0	7.54	488
Whole	89.8	6.80	441
Buttermilk	13.9	.17	11
Skim	11.3	.37	24
Chocolate (commercial)	3.9	.07	5
Half and half, extra rich	19.0	.12	8
Processed milk:			
Evaporated	40.0	.36	23
Condensed	2.9	.02	1
Dry, total	16.8	.03	2
Nonfat	11.4	.02	1
Whole	1.8	.01	(*)
Products, nonfat and whole[2]	5.4	.01	(*)
Cream, total[3]	27.7	.10	7
Light	7.1	.03	2
Heavy, whipped, whip topping	21.3	.07	5
Ice cream, ice milk (commercial)[4]	57.1	.41	27
Cheese, total	84.9	.43	28
Cottage	51.8	.23	15
Nonprocessed, total[5]	35.2	.08	5
American-type	21.4	.06	3
Swiss	2.8	(*)	(*)
Cream	9.4	.01	1
Other	7.1	.01	1
Processed, total[6]	50.6	.12	8
American, Swiss, cream, other	40.9	.11	7
Cheese spreads	9.4	.01	1
Fats and oils, total	99.1	0.92	60
Table fats, total	97.8	.43	28
Butter	53.4	.18	12
Margarine	66.2	.25	16
Shortening, total	68.9	.22	14
Lard[7]	12.7	.06	4
Other	59.0	.16	10
Salad and cooking oils	39.0	.09	6
Salad dressings (commercial), total	77.4	.18	12
Mayonnaise and mayonnaise-type	47.8	.09	6
French and french-type	23.2	.03	2
Other[8]	26.0	.08	5

*Less than 0.005 pounds or 0.5 grams.

[1] Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.

[2] Chiefly dry cocoa mixes.

[3] Includes small amounts of powdered cream, not shown separately.

[4] Includes frozen custard and frozen desserts with vegetable fats.

[5] Includes quantities of cheese for which respondent could not report whether or not processed.

[6] Includes small amounts of cheese food, not shown separately.

[7] Includes small amounts of chicken fat.

[8] Includes sandwich spreads.

61<

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Flour and other cereal products, total	97.7	1.48	96
Flour other than mixes, total	79.5	.66	43
White	78.6	.63	41
Other	3.5	.03	2
Prepared flour mixes, total	50.8	.26	17
Pancake	20.7	.07	4
Cake	22.9	.11	7
Biscuit, roll, muffin	20.2	.06	4
Other	7.2	.02	1
Breakfast cereals (excluding baby cereals), total	80.5	.28	18
Ready-to-eat, total	66.4	.16	7
Corn flakes	32.8	.04	3
Wheat, flaked, puffed, shredded	37.3	.07	5
Rice, flaked, puffed, etc	17.2	.02	1
Other	19.4	.03	2
Hot, total[9]	44.6	.11	7
Rolled oats, oatmeal	31.4	.06	4
Wheat cereals	21.0	.04	3
Other cereals, total	69.8	.28	18
Baby cereals	7.5	.01	1
Rice	28.3	.07	5
Cornmeal, grits, total	10.8	.03	2
Cornmeal	10.4	.03	2
Hominy grits	.9	(*)	(*)
Hominy (big)	3.2	.02	1
Macaroni, spaghetti, noodles	41.3	.12	8
Popcorn	10.6	.02	1
Other[10]	15.9	.01	(*)
Bakery products, total	98.4	2.14	138
Bread, total	93.4	1.55	100
White[11]	78.6	1.21	79
Whole wheat	25.6	.18	12
Other	30.4	.15	10
Baked goods other than bread, total	82.2	.59	38
Crackers, total	54.1	.15	9
Sweet	14.4	.04	2
Not sweet	48.7	.11	7
Rolls, total	19.2	.06	4
Ready-to-eat	12.5	.03	2
Brown and serve	7.7	.02	1
Biscuits, muffins	7.0	.02	1
Cakes	18.7	.10	6
Pies	11.0	.08	5
Other[12]	49.0	.19	13

[9] Includes small amounts of other hot cereals not shown separately

[10] Includes tapioca, cornstarch, barley, buckwheat grits.

[11] Practically all reported as enriched.

[12] Includes cookies, doughnuts, sweet buns, coffee cake, etc.

402

62<

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Eggs	96.8	0.96	62
Meat, poultry, fish, total	99.4	4.34	281
Meat, total	99.4	3.37	218
Beef, total	93.5	1.62	105
Steak, fresh, frozen, total	60.3	.52	34
Round	29.5	.19	12
Other	40.6	.33	22
Roast, fresh, frozen, total	37.1	.47	30
Rib	7.6	.10	6
Other	30.1	.37	24
Stewing, boiling, fresh, frozen	20.7	.13	9
Corned, chipped, dried	3.8	.02	1
Ground, fresh, frozen	63.5	.47	30
Canned (commercial)	5.0	.02	1
Veal, total[13]	11.1	.07	5
Roast, shoulder, fresh, frozen	3.0	.03	2
Chops, cutlets, fresh, frozen	7.6	.04	3
Pork, total	87.7	1.00	65
Fresh, frozen, total	47.7	.40	26
Chops	27.9	.16	10
Ham	3.4	.03	2
Loin	6.2	.08	5
Sausage	17.9	.07	4
Other	7.5	.07	4
Cured, smoked, total	79.9	.54	35
Ham, raw, precooked	24.5	.20	13
Bacon	70.6	.27	18
Salt pork	3.1	.01	1
Other	8.3	.05	3
Canned (commercial)	4.7	.06	4
Lamb, mutton, total	18.9	0.13	9
Chops, steak, fresh, frozen	13.6	.07	4
Roast, shoulder, leg, fresh, frozen	4.2	.05	3
Stewing, soup, ground, patties	2.0	.01	1
Variety meats and game, total	26.5	.17	11
Liver	18.4	.06	4
Other	11.9	.10	7
Luncheon meats, total	69.7	.37	24
Frankfurters	36.2	.16	10
Other, total	56.2	.21	14
Canned	8.5	.02	1
Other	52.4	.19	13
Poultry, total[15]	48.1	.61	39
Chicken[16]	46.4	.55	36
Turkey[16]	2.8	.05	3

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[13] Includes small amounts of other veal, not shown separately.

[14] Includes tongue, kidney, heart, tripe, etc.; game.

[15] Includes small amounts of other poultry, not shown separately.

[16] Chiefly fresh or frozen, only small amounts of canned reported.

403

63<

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Meat, poultry, fish—Con.			
Fish and shellfish, total	67.5	.37	24
Fish, total[17]	60.7	.29	19
Canned (commercial), total	40.0	.10	6
Salmon	7.8	.02	1
Tuna	30.8	.06	4
Other[18]	6.4	.02	1
Fresh, frozen	28.8	.19	12
Shellfish, fresh, frozen, canned	16.6	.08	5
Sugar, sweets, total	97.6	1.20	78
Sugar, total	95.3	.75	49
White, total	94.6	.70	46
Granulated	94.2	.63	41
Confectioners, powdered	23.6	.08	5
Brown	23.1	.05	3
Sirups, molasses, honey, total	49.1	.13	9
Sirups, total	40.5	.10	6
Corn, cane	11.7	.03	2
Maple, sorghum, other[19]	30.5	.07	5
Molasses	2.5	(*)	(*)
Honey	13.7	.03	2
Jellies, jams, total	69.8	.18	12
Jellies	30.0	.06	4
Jams, preserves, fruit butters, etc.	47.6	.12	8
Candies (commercial), total	49.8	.13	9
With nuts	18.3	.04	3
Without nuts	38.7	.09	6
Potatoes, sweetpotatoes, total	94.3	1.70	110
Fresh, total	91.8	1.62	105
White	91.0	1.59	103
Sweetpotatoes	4.7	.03	2
Frozen[20]	4.4	.01	1
Canned, dehydrated[21]	6.0	.03	2
Potato chips and sticks[22]	23.8	.04	3
Fresh vegetables, total[23]	98.5	2.76	179
Dark green and deep yellow, total[24]	77.0	.43	28
Dark green leafy, total	22.7	.09	6
Spinach	8.1	.03	2
Other	16.9	.06	4
Broccoli	5.2	.03	2
Carrots	64.6	.29	19
Peppers, green	18.8	.02	1

[17] Includes small amounts of smoked, cured fish, not shown separately.
[18] May include small amount of ready-cooked fish, not canned.
[19] See page 61 for chocolate sirup.
[20] Chiefly french fried.
[21] Chiefly canned sweetpotatoes.
[22] Chiefly chips.
[23] Includes home canned and frozen vegetables that were brought into the home in fresh form.

404

TABLE XIV.–FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955–Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)
	Percent	Pounds	Grams
Fresh vegetables, Con.			
Other green, total	91.5	1.03	67
Asparagus	29.0	.18	12
Beans, snap, wax	11.1	.06	4
Cabbage	27.3	.18	12
Lettuce	81.8	.52	34
Peas	6.0	.03	2
Other	11.0	.05	3
Tomatoes	65.4	.35	22
Other than tomatoes and green and deep yellow, total	93.7	.94	61
Celery	53.3	.18	12
Cucumbers	23.2	.08	5
Mature onions	73.6	.24	16
Green onions	39.9	.11	7
Other, total[25]	52.4	.33	22
Corn	14.1	.11	7
Fresh fruits, total[26]	96.7	3.18	206
Citrus, total[27]	74.6	1.30	84
Grapefruit	29.5	.41	26
Lemons, limes[28]	33.6	.09	6
Oranges	54.4	.81	52
Other than citrus, total[29]	91.0	1.88	122
Apples	49.1	.42	27
Bananas	60.6	.44	29
Melons	12.1	.30	20
Rhubarb	9.4	.07	5
Strawberries	27.4	.16	10
Avocados	25.8	.10	7
Berries other than strawberries	5.7	.04	3
Cherries	7.0	.05	3
Peaches	13.8	.12	8
Other	18.0	.16	10
Commercially frozen fruits and vegetables	40.9	.21	14
Fruits[30]	8.4	.03	2
Vegetables other than potatoes, total	37.2	.19	12
Beans, lima	6.3	.01	1
Beans, snap, wax	6.9	.02	1
Broccoli	7.5	.02	1
Peas	20.9	.06	4
Spinach	7.1	.02	1
Corn	5.7	.02	1
Other	14.7	.04	3

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[24] Includes other dark green and deep yellow vegetables not shown separately.

[25] Includes beets, cauliflower, turnips, rutabagas, and others not shown separately.

[26] Includes home canned and frozen fruits that were brought into the home in fresh form.

[27] Includes small amouts of tangerines and kumquats not shown separately.

[28] Chiefly lemons.

[29] Includes small amounts of figs and grapes not included in "Other."

[30] Chiefly strawberries.

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955—Con.

65<

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	Quantity per person Per day (4)
	Percent	Pounds	Grams
Commercially canned fruits and vegetables, total....	90.6	1.48	96
Fruits, except baby and junior foods, total.........	62.9	.54	35
Apples, applesauce....	13.8	.06	4
Apricots....	8.4	.04	2
Berries....	4.5	.02	1
Cherries....	5.8	.02	1
Peaches....	25.5	.16	10
Pears....	12.9	.06	4
Pineapple....	21.5	.08	5
Plums, prunes....	2.9	.02	1
Mixed fruit, fruit cocktail....	15.6	.07	4
Other....	5.6	.03	2
Baby, junior foods, incl. juices....	8.8	.05	3
Vegetables, except baby and junior foods, total[31]	78.9	.86	56
Asparagus....	6.9	.03	2
Baked beans, or other mature beans....	12.3	.07	5
Beans, lima, green, immature....	1.5	.01	1
Beans, snap, wax....	38.5	.18	12
Beets....	15.2	.05	3
Corn....	32.4	.14	9
Peas, green, immature....	32.9	.14	9
Tomatoes, total....	21.7	.11	7
Pulp....	15.0	.09	6
Puree, paste....	8.8	.02	1
Other....	31.1	.12	8
Baby, junior foods, incl. potatoes....	6.3	.03	2
Fruit and vegetables juices, fresh, frozen, canned, powdered[32, 33]....	63.4	1.15	74
Canned citrus, total[32, 34]....	21.2	.27	17
Orange....	11.4	.16	10
Grapefruit....	8.5	.09	6
Canned fruit other than citrus[32]....	21.8	.20	13
Canned tomato and other vegetable juices[32, 35]..	22.8	.21	14
Frozen, concentrated, total....	26.0	.13	8
Orange....	22.2	.10	7
Other....	7.9	.02	1
Fresh (commercial)....	1.4	.01	1
Dried fruits and vegetables, total[36]....	49.9	.21	13
Dried fruit, total....	31.6	.07	5
Prunes....	9.5	.02	1
Raisins, currants....	20.0	.03	2
Other....	7.1	.02	1

[31] Includes small amount of mature peas not included in "Other."

[32] Single strength equivalent.

[33] Does not include baby or junior juices. See above.

[34] Includes orange and grapefruit blend and other citrus juices not shown separately.

[35] Includes both commercially and home-canned and frozen juices.

[36] Includes both commercially and home-dried fruits and vegetables.

66<

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Dried fruits and vegetables—Con.			
Dry vegetables, total	28.1	.13	9
Beans, total	24.3	.13	8
Lima	3.1	.01	1
Navy, pinto, kidney, other	21.7	.12	8
Peas, lentils, other	6.1	.01	(*)
Beverages:			
Coffee, total[37]	92.4	0.30	19
Bean, ground	81.4	.29	19
Instant, powdered	18.2	.01	(*)
Substitute	3.5	(*)	(*)
Tea[38]	17.1	.02	1
Chocolate, cocoa, chocolate sirup, total	25.6	.02	1
Chocolate	8.1	.01	1
Cocoa	17.3	.01	1
Chocolate sirup	1.7		(*)
Soft drinks, fruit ades, total	52.0	.70	45
Soft drinks, bottled and canned, total	43.9	.65	42
Cola-type	27.6	.37	24
Fruit flavored	10.3	.10	7
Other	17.7	.17	11
Powdered	8.1	.01	(*)
Fruit ades, total	8.6	.04	2
Frozen	6.7	.02	1
Other	2.1	.02	1
Miscellaneous foods:			
Nuts (shelled weight) and peanut butter, total	55.5	0.10	7
Nuts (shelled weight), total	27.3	.04	3
Peanuts	6.7	.01	1
Other	22.4	.03	2
Peanut butter	39.0	.06	4
Soups, except canned baby soups, total	57.0	.34	22
Vegetable, total	36.8	.18	12
Condensed	33.0	.16	10
Other	3.5	.01	1
Meat, fish, grain, total	36.0	.17	11
Condensed	30.6	.15	10
Other	6.8	.01	1
Catsup, chili sauce, etc., total[39]	62.2	.16	10
Catsup	47.1	.07	5
Chili sauce	5.1	.01	(*)
Barbecue sauce, etc.	22.6	.07	5
Tomato relishes	3.5	.01	(*)
Pickles, olives, relishes, total[39]	47.3	.15	9
Pickles	35.7	.11	7
Olives	15.7	.03	2
Relishes other than tomato	5.5	.01	1

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[37] Includes small amounts of liquid concentrate coffee, not shown separately.

[38] Data refer to amounts bought during the 7-day survey period rather than the amounts used.

[39] Includes both commercial and homemade products.

407

67

TABLE XIV.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE WESTERN REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Miscellaneous foods--Con.			
Puddings, pie fillings, miscellaneous sweets (commercial), total[40]	48.2	.11	7
Puddings, pie fillings[41]	41.9	.06	4
Strained canned puddings (baby)	2.9	.01	(*)
Sherbets, ices	7.8	.03	2
Icing mix, fudge mix	4.0	.01	(*)
Other mixtures, prepared or partially prepared, total	36.7	0.24	15
Mixtures other than baby, junior foods, total	31.4	.19	12
Without meat[42]	11.6	.05	3
With meat[43]	24.2	.14	9
Baby, junior foods, total	7.9	.05	3
Meat, mixtures with meat	7.9	.04	3
Without meat	1.2	(*)	(*)
Leavening agents, total[44]	18.9	.03	2
Yeast	11.5	(*)	(*)
Other[44]	9.2	.03	2
Seasonings[44]			
Vinegar	9.7	.06	4
Salt	19.7	.10	6

[40] Includes other miscellaneous sweets not shown separately.

[41] Chiefly dry, including plain gelatin.

[42] Includes spaghetti with tomato sauce, potato salad, cole slaw, macaroni and cheese dinners, chow mein and chop suey dinners, and others.

[43] Includes poultry and meat pies, spaghetti with meat balls, corned beef hash, chili con carne, ravioli, tamales, and others.

[44] Data refer to amount bought during the 7-day survey period rather than the amounts used.

4 3

THE CESIUM-POTASSIUM TREND IN HUMANS AT CHICAGO AS A FUNCTION OF TIME*

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"The total-body gamma-ray spectra of 13 unexposed employees of the Argonne National Laboratory chosen to be typical of the civilian population of the Chicago area have been measured periodically for cesium-137 (Cs^{137}) since March 1955.[1]

"Their Cs^{137} body contents have been determined and are reported in units of $\mu\mu c$ Cs^{137} per gram of natural body potassium (K). The Cs/K ratios of eight subjects are presented in Table XV for six dates during the past 18 months. It will be noted that the average value rose from 50 $\mu\mu c$ Cs^{137}/gm of K in July 31, 1958 to a high of 64.4 $\mu\mu c$ Cs^{137}/gm of K in June 1959, and fell to 55 $\mu\mu c$ Cs^{137}/gm of K in December 1959. The data for the other five subjects are not included since they were not counted on one of the six dates. This omission does not alter the average ratio by more than 3 percent.

TABLE XV.--CESIUM-137 POTASSIUM-40 RATIOS IN EIGHT CONTROL SUBJECTS OVER A SPAN OF 18 MONTHS

Subject	7/31/58	11/20/58	3/19/59	6/17/59	9/14/59	12/8/59
C.L.	57	48.5	59	68.5	60	56.2
I.S.	51.5	52	59	54.6	54.5	47.4
H.M.	71.0	68.5	75.2	83.2	68.2	69.5
C.M.	43	58	76	81	64.2	62
B.O.	47	47.8	54.5	57.2	45.5	42.2
B.P.	43.5	46.2	53.5	59	54.7	53.5
R.R.	39	39.5	47	46	45.6	45.2
O.S.	48.4	51	61.8	65.5	64	63.1
Average	50	51.4	60.7	64.4	57.1	55

"Mr. Ingvar Andersson, Atomic Energy Company, Stockholm, Sweden, measured 19 females during May and 27 males during June of 1959, finding a Cs^{137}/K ratio of 57 $\mu\mu c$ Cs^{137}/gm of K for the females and 73.5 $\mu\mu c$ Cs^{137}/gm of K for the males.[2] He also measured the author's content on June 1, 1959, and found a value in excellent agreement with the Argonne value. Thus, the results from these two laboratories can be compared directly.

"Each of the above subjects was showered thoroughly before being counted and each wore special low-background coveralls during the measurements. A number of control subjects, measured while attired in their normal street clothes, apparently contained from 5 to 10 percent more Cs^{137}. Mr. Andersson likewise counted subjects while they were wearing first street clothes and then, special low-background clothing. He reported that subjects yielded a total counting rate of 30 percent higher when dressed in street clothing.

References

1. Miller, C. E., and L. D. Marinelli. In vivo Measurement of Cs^{137}. Argonne National Laboratory Radiological Physics Division of Semiannual Report, January through June 1958. ANL-5919, pp. 74-76.
2. Andersson, I. Gamma Radioactivity of Swedish People Measured During May and June 1959. FOA-2 Rapport, A-2051-2097, Stockholm (September 1959).

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*Argonne National Laboratory, Lemont, Illinois, operated by the University of Chicago, under contract with the U. S. Atomic Energy Commission, reported in ANL-6104, 1960."

DELAWARE RIVER SURVEILLANCE SUMMARY REPORT*

69< Surveillance activities of the Delaware River in the area of Camden, New Jersey, were started about August 1958. In the Spring of 1959 the sampling program was expanded from the Camden area to Trenton, New Jersey. Background information on the radioactivity of the environment was desired prior to the completion of the Nuclear Ship SAVANNAH being built in the New York Shipbuilding Company's yard at Camden. The nuclear operation involves the construction and testing of a shipborne pressurized water reactor. The clad fuel elements are moderated and cooled by recirculating demineralized light water in a closed system. The steam system is separate, being only in thermal contact with the primary system through a heat exchanger. Total containment of the liquid wastes is projected for this reactor with final disposition through an onshore facility. Waste treatment by ion exchange is provided on board. Replacement of fuel elements and decontamination, will be provided by a barge facility. Airborne activity is expected to be relatively minor, consisting primarily of air purged from the reactor enclosure.

The normal use of the Delaware River is for navigation, a source of potable water, a source of industrial water and a source of edible shellfish in the Bay area. Some river water may be used for irrigation purposes. The surrounding area not only has a high population density, but it is also an important agricultural area. Because of these diverse uses of the area, a wide variety of sample types have been taken with the major emphasis on the water environment, since most of the waste will be in the aqueous primary coolant from the SAVANNAH.

Environmental Samples

A variety of sample types were taken from the environment on a routine basis. These included water samples taken from the Chesapeake Bay, Delaware River and its tributaries; silt samples above and below the shipyard in the River and the Bay; biological samples including algae, shellfish and plankton; precipitation samples; crop samples; soil and fertilizer samples used in the areas where the crop samples were grown; milk samples from two locations, one in Pennsylvania and one in New Jersey; and animal thyroid samples. No air samples were collected since data were available from the National Air Sampling Network.

Analysis

All of the collected samples were sent to the Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for analysis.

Participating Agencies

The Delaware River Surveillance Program was a joint effort of the Federal, State and City Governments and private industry. Those organizations participating were:

Maritime Administration, Department of Commerce
Public Health Service, Department of Health, Education, and Welfare
Atomic Energy Commission
Interstate Commission of the Delaware River
Pennsylvania Department of Public Health
New Jersey Department of Health
Delaware State Board of Health
City of Philadelphia Department of Health

Conclusions

"In view of the changing pattern of fallout, i.e., decreasing levels of radioactivity in the absence of new weapons tests and the absence of short-lived radionuclides generally associated with such tests, the data obtained appear to be highly variable. This is particularly true when one examines the gross activity data in precipitation and in surface waters. A certain level of stability is apparent when one considers the strontium-90 data. Some fluctuation exists, particularly in precipitation as a function of time, but by and large, strontium-90 levels are low.

Silt radioactivity levels are comparable with those encountered in other estuaries along the East Coast. Algea and plankton showed some accumulation of gross acitvity with lower levels showing up in the more recent collections. The small sample volume made strontium-90 determinations unprofitable.

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*The complete report is entitled "Delaware River Surveillance Report of Progress, January 1-December 31, 1959," by Conrad P. Straub and Paul F. Hallbach, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio.

410

Levels of gross activity and strontium-90 in the two shellfish samples were low. Of interest was the fact that zinc-65 was found in both samples.

"Soil and crop gamma radioactivity levels were determined and showed the presence of fission products in both soil and fertilizer samples, while little of this material appeared in the edible portions of crops tested. The bulk of the radioactivity in these foods was from naturally-occurring potassion-40 and to a somewhat lesser extent radium-226. Strontium-90 levels, particularly on a wet-weight basis, were extremely low reflecting in part the nature of the soil in which these crops were grown. Soil strontium-90 values were low due in all probability to the sandy nature and high permeability of the soil."

The survey on the Delaware River was considerably more extensive than would be necessary in other areas, but it is believed that from these results an optimal program, applicable to other areas, will result. Sampling of the environment will continue as required by nuclear ship operations in the Camden area. Data from samples collected after the startup of the reactor will be presented in Radiological Health Data as soon as it becomes available.

RADIOACTIVE FALLOUT FROM NUCLEAR DETONATIONS OF FEBRUARY AND APRIL 1960

71< The Fallout Studies Branch, Division of Biology and Medicine, U. S. Atomic Energy Commission, has published a report entitled "Radioactive Fallout from Nuclear Detonations of February and April 1960" which is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. The following is a summary of that report. The complete document presents concentrations of radioactivity in air and precipitation.

RADIOACTIVE FALLOUT FROM NUCLEAR DETONATIONS OF FEBRUARY AND APRIL 1960

Alfred W. Klement, Jr.
Fallout Studies Branch, Division of Biology and Medicine

"On February 13, 1960 the French Government announced[1] that its first nuclear weapon was detonated at Reggan in the Sahara at 7:00 a. m. on February 13, 1960. Following this detonation increases in fallout radioactivity were observed at a number of fallout collection network stations in the United States and elsewhere. A second detonation was announced on April 1, 1960. Since these observations are of interest in the study of the mechanisms of fallout, much of the data available pertaining to the French tests are provided or summarized in this report.

"Reports from the U. S. Public Health Service and U. S. Naval Research Laboratory networks and from AEC installations have shown transient increases in radioactivity in air and precipitation samples at some stations during the latter part of February and in March 1960. The identification of short-lived radioisotopes and the rapid decay of samples indicate that this debris originated about mid-February and early April 1960 and it appears to be from the announced nuclear detonations in the Sahara Desert on February 13 and April 1, 1960. The data available so far show relatively small increases in fallout which persists for only a few days. These levels are very much less than those which were observed in the spring of 1959. This fresh debris will not add more than one to two tenths of a percent to the total world-wide fallout of long-lived fission products.

FALLOUT STUDIES

"Some recent results of the U. S. Atomic Energy Commission's fallout studies program are summarized below. While these provide a great deal of data from locations through the world, it was intended that they furnish information over a long period of time from selected locations which could be used to improve our understanding of fallout phenomena, rather than merely to provide data on environmental levels of radiation throughout the world. Reference should be made to the 1959 Annual Report[1] for a more complete description of individual programs. This summary was prepared by the Division of Biology and Medicine, Atomic Energy Commission.

Fallout Measurements in Soil, Precipitation and Air

"Measurement of strontium-90 levels in soil sampled at locations throughout the world was made during 1959 cooperatively by the Commission's Health and Safety Laboratory and the U. S. Department of Agriculture. Such measurements provide information on the total strontium-90 deposition from past weapons tests. During 1959, soil samples were obtained from nearly all states of the United States as compared with only 17 locations in previous years. Not all of the regular foreign stations were sampled in 1959 since this program provides for complete world-wide sampling every two years. The 1959 foreign sampling was planned to give information on the rapid stratospheric fallout in the Northern Hemisphere resulting from the far northern tests of 1958. The 1959 results were summarized in a previous report.[2] Results for 1958 are shown also where available.

"The increase in strontium-90 on the ground from 1958 to 1959 agrees with findings from monthly collections of fallout obtained during that time. Monthly collections (steel pots, ion-exchange, precipitation) at the world-wide network of stations showed the highest rate of fallout in early 1959, followed by a decreased rate. In the last quarter of 1959 a few collections in the United States showed a trend toward some increase in fallout rate but less than the highest rate observed earlier in 1959. Too few data for 1960 are available at this time for further conclusions as to seasonal variations.

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[1] Ambassade de France, Service de Presse et d'Information, Release No. 886, New York, February 13, 1960, "France's First Atomic Explosion."

See references 1-6 on page

"Rhodium-102 produced in tracer amounts at a high altitude, and tungsten isotopes produced in other shots during the 1958 U. S. Pacific tests, provided a means of studying the transport and rate of fall of radioactive debris in the stratosphere. Such studies are being made by the Air Force Cambridge Research Center with partial support by the Commission. The results obtained so far imply that the time required for high stratospheric material to fall out to the surface is much longer than for low stratospheric material. Also, comparisons between rhodium and tungsten indicate a different mixing history of the debris in the upper and lower stratosphere. However, neither the distribution nor the residence time of the rhodium-102 has been well established as yet. In addition to these studies, stratospheric inventory studies by means of ballon sampling were continued at San Angelo, Texas, during 1960 under the scientific direction of the U. S. Weather Bureau. Current results from this program are not yet available, however. Levels of gross or total fission product beta radioactivity in surface air continued to decrease during the period July to December 1959 in the Northern Hemisphere. Some stations remained relatively stable from October through December. As expected from current concepts of fallout deposition, a seasonal rise in air concentrations of fallout radioactivity was seen at some stations during the first three months of 1960 in the Northern Hemisphere. However, the levels remain lower than the peak values of the Spring of 1959. At many locations no increase has been detected so far in 1960 and at most of the United States stations operated by the Public Health Service, levels have been below the limit of reliable measurement during the period September 1959 to February 1960. Levels in the Southern Hemisphere remained very low and relatively stable since July 1959. Some increases have been found at Southern Hemisphere stations in early 1960 although levels remain much below those in the Northern Hemisphere. Seasonal changes, if any, have been too small to detect.

"Reports from the Public Health Service and Naval Research Laboratory networks and from AEC installations have shown transient increases in radioactivity in air and precipitation samples at some stations during the latter part of February and in March and April 1960. The identification of short-lived radioisotopes and the rapid decay of samples indicate that this debris originated about mid-February and early April 1960 and it appears to be from the nuclear detonations in the Sahara Desert on February 13, 1960 and April 1, 1960.[3]

"The peak monthly levels of fallout radioactivity (dose rate) at Argonne National Laboratory due to past tests occurred in April and May 1959.[4] The rate of fallout diminished in a few months to only a few percent of the peak rate. Long-lived cesium-137 is still accumulating slowly, having reached a relatively stable value of about 200 millicuries per square mile in early 1960. According to the activity ratio between cesium-137 and strontium-90, determined at Argonne to be 1.6, the corresponding amount of strontium-90 in soil would be 125 millicuries per square mile. Radioactivity from the first French atomic test was observed in snow during late February, but not positive sign of activity from this source was found in either soil or air samples. Integration of the whole-body dose from fallout based upon these measurements shows an expected increase of 1.5 to 3.3 percent in the thirty-year genetic and seventy-year lifetime doses over that arising from natural radiation in the Chicago area.

"The Los Alamos Scientific Laboratory and the University of California at Los Angeles have studied fallout at the Nevada Test Site and adjacent areas during all test operations at the Site. The most recent work involved the 1959 test of Kiwi-A (a nuclear reactor-type propulsion device, part of the Rover Project).[5] Since the nature of this device was such that a fundamentally different type and much smaller amount of air-borne material might be produced than that from weapons tests, studies were undertaken to measure particle size, air concentration, and ground deposition in detail. Particle sizes found were smaller than those produced in bomb testing, reflecting the selective diffusion, or fractionation, process involved in the release of fission products. Materials of longer half-life appeared to be associated with smaller particles. Deposition velocities calculated at certain points showed wide variations from point to point and were generally larger than would be predicted from the measured particle sizes.

"The fallout pattern was very narrow and the levels of radioactive contamination were very erratic (off-site fallout was negligible). Attempts to combine the data with meteorological measurements indicated that the pattern could not be explained by either existing models from weapons tests or well known diffusion models for stack effluents. A new type of model for this kind of dispersion is under investigation and will be checked during future tests.

Fallout Measurements in Foods and in Man

"Studies were continued of uptake of fallout material in foods involving the collection and analysis of milk, animals, certain fresh vegetables, forage crops and wheat. The recent results of these studies have been reported.[6]

"Studies at Los Alamos of carbon-14 in lemongrass and citrus oils from a number of locations have shown a steady increase of carbon-14 content in these oils. By mid-1959, the carbon-14 activity in the troposphere and in the rapidly equilibrating biosphere (as represented by lemongrass and citrus oils)

73< appears to have increased by about 27 percent in the Northern Hemisphere and 20 percent in the Southern Hemisphere.

"As previously reported (e.g., in the AEC's semiannual Report for January-June, 1958), the Los Alamos Whole Body Liquid Scintillation Counter has been used to study cesium-137 levels in people and foodstuffs since the spring of 1956. Levels in the United States and Canadian powdered milk supply have been followed in considerable detail. The sampling network has grown to a total of fifty-five stations sampled once each week. The purpose of the study is not to monitor Cs^{137} levels in milk *per se* but to study fallout mechanisms and correlate the average levels in milk with those in the population.

"It is interesting that 1959, the first year without weapons tests, has shown both the highest and lowest Cs^{137} concentrations yet observed in milk from several locations. Certain high peaks in May are perhaps a delayed reflection of the intense testing during late 1958, and the stratospheric injection of large amounts of contamination at far northerly latitudes. The unusually low levels being reached by many areas in the fall of 1959 may result from the first "clean" troposphere during the period of observation.

"Cesium-137 values for both people and milk have risen slowly and irregularly over the period of observation, at average annual rates of roughly 10 and 5 $\mu\mu$c/gm potassium, respectively. The pronounced peaks in milk levels were due, in part, to intense tropospheric fallout, as shown by the presence of barium-lanthanum-140 activity. In addition, a seasonal pattern of milk activity, such as might be expected from changes in food sources of the dairy herds, is indicated. A somewhat similar but less pronounced variation is evident in the Cs^{137} data on people. A more detailed analysis of the data shows that the maximum and minimum levels in people lag behind those of milk by about one-quarter of a year. A lag time of this magnitude between people and milk may be expected, since the biological half-time of Cs^{137} in man is about 120 days and milk is usually consumed soon after production.

TABLE 1.--CESIUM-137 IN U. S. PEOPLE AND MILK

Samples for periods shown	January-August 1959 $\mu\mu$c Cs^{137}/gm K	Late 1959-Early 1960 $\mu\mu$c Cs^{137}/gm K
Highest Cs^{137} in milk................	297	114
Lowest Cs^{137} in milk..................	7	5
Highest Cs^{137} in people.............	170	113
Lowest Cs^{137} in people...............	37	42

"Studies of human bone levels of strontium-90 were continued by the Lamont Geological Observatory, Columbia University, during 1960. The results of analysis through 1959 have been evaluated in terms of dietary levels of strontium-90 and predictions of future levels have been made. The concentration of strontium-90 in human bone continued to increase in 1958 and 1959. The concentration of strontium-90 in adult bone is independent of the age of the individual. The average level in the Northern Hemisphere for Western culture adults is about 0.30 micromicrocuries of strontium-90 per gram of calcium for 1959. The 1958 level was about 0.20. The highest average concentration for any age group in 1959 was about 2.1 for one-year-olds (Western culture) and levels in children vary strongly with age. The investigators predict that maximum bone levels will probably be reached during 1960, based on current estimates of dietary levels of strontium-90 and their relationship to rate of fallout and total deposition. It was predicted by the Lamont group that strontium-90 in present one-year olds will drop rapidly to a level of 0.9 in 1970 if there is no further atmospheric contamination. Previous estimates, based on earlier data and concepts, placed higher maximum levels at a later period (1962-1965). The present predictions are based on a particular hypothesis and are subject to considerable uncertainty."

References

1. Atomic Energy Commission, Annual Report to the Congress (January-December 1959, pages 239-266).
2. Radiological Health Data, September 1960 and AEC Health and Safety Laboratory Report, HASL-88, July 1, 1960.
3. See Radioactive Fallout from Nuclear Detonations of February and April 1960, page 66, this issue.
4. Radiological Health Data, Quarterly Report, July 1960.
5. Annual Report, U. S. Atomic Energy Commission, January-December 1959, page 77.
6. AEC, Health and Safety Laboratory Report, HASL-88, July 1, 1960.

74<

RADIOLOGICAL HEALTH DATA

MONTHLY REPORT

NOVEMBER 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Radiological Health

PREFACE .

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing ***Radiological Health Data.*** This publication is issued monthly, with each third issue (starting July 1960) expanded into a quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

76<

TABLE OF CONTENTS

Page
PREFACE iii

SECTION I.--MILK

Public Health Service Milk Monitoring Program 1
Data on Radioactivity in Milk (June 1960) 3
Data on Radioactivity in Milk (April-June 1960) Health and Safety Laboratory, Atomic Energy Commission 6
Secretion of Dietary Strontium-90 and Calcium in Human Milk 6

SECTION II.--AIR

Public Health Service Radiation Surveillance Network 8
Radioactivity of Particulates in Air-Gross Beta Counts (June 1960) 10
Radon and Thoron Measurements (June 1960) 11
Public Health Service National Air Sampling Network 12
Gross Beta Radioactivity in Air (First Two Quarters 1960) 14
Gross Beta Activity in Precipitation (First Two Quarters 1960) 17
U. S. Naval Research Laboratory Radioactivity Measurements (June 1960) 19
Daily Record of Fission Product Beta Activity 19

SECTION III.--WATER

Public Health Service National Water Quality Network 22
Radioactivity in Raw Surface Waters (May 1960) 24
Monitoring Water Supplies Around the Nevada Test Site (May-June 1960) 27

SECTION IV.--OTHER DATA

External Gamma Activity--Public Health Service Radiation Surveillance Network (June 1960) .. 29
Summary of Research Results Related to Environmental Radioactivity--Atomic Energy Commission 30
Environmental Levels of Radioactivity at Atomic Energy Commission Installations 32
Aircraft Nuclear Propulsion Department, General Electric Company 32
Bettis Atomic Power Laboratory, Westinghouse Electric Corporation 33
Connecticut Aircraft Nuclear Engine Laboratory, Pratt & Whitney Aircraft, Division of United Aircraft Corporation 36
Mound Laboratory, Monsanto Chemical Company 38
Portsmouth Gaseous Diffusion Plant, Goodyear Atomic Corporation 40
SIC Prototype Reactor Facility, Combustion Engineering, Incorporated 43
Weldon Spring Plant, Mallinckrodt Chemical Works Uranium Division 45
Strontium-90 in Wheat and Wheat Products, Atomic Energy Commission 47
Montefiore Hospital Metabolic Studies, Atomic Energy Commission 51
Short Term Training in Radiological Health—Public Health Service 51

SECTION I.—MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The original Public Health Service Milk Monitoring Program consisted of 12 sampling stations. This has now been expanded to include an additional 60 stations. Since the sampling procedures for the original and the added stations are somewhat different, they will be described and reported separately. The Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, continues to conduct the analyses for the original network stations while the Public Health Service Southeastern Radiological Health Facility, Montgomery, Alabama, and the Southwestern Radiological Health Facility, Las Vegas, Nevada, provides this service for the added stations.

Original Stations

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing since it is among the most important components of the diet and is available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs. Since this program has been in operation for over three years, its contribution of information is significant.

The selection of the original sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.

2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.

3. The milk samples were from a supply that was part of a metropolitan milkshed.

4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000 cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000 gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separation, and the strontium-90 is calculated by measuring the build-up in a two-week period of the daughter decay product, yttrium-90 using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

Publication of the data will normally follow about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

April through September 1960 issues of Radiological Health Data list references for technical descriptions of the methodology of analyses used.

Table 1 presents the data for June for the original stations.

78<

Added Stations

The Milk Montoring Program is being expanded for the primary purpose of providing additional information on levels of radiation in milk consumed by the public. The new stations are being established in cooperation with State and local health and milk sanitation agencies. The cities have been selected in order to provide adequate coverage from the combined viewpoints of production areas and consuming population. The emphasis on this expanded sampling and radioassay program is that of:

1. Measuring the levels of radionuclides in the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the point of distribution to the public.

2. Providing one sampling point within each state with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of large population groups. This differs from the original set of sampling stations whose selection was based principally upon certain criteria involving the milk production and milkshed area characteristics.

In some instances the designated points are the same as those which reported originally. The establishment of the added sampling stations does not preclude the need for further samples from the selected milksheds serving the same cities. It is important that both networks be in operation for a sufficient period of time to provide an overlap for purposes of comparative study.

The sampling procedure has been developed to give a sample from one day's sales per month in a community which will be as representative of the total supply as can be achieved under practical conditions. The sample will be a composite of those plants supplying not less than 90% of the city's milk supply. The contribution from each plant to the total sample will be approximately proportional to volume of milk sold.

The samples from the added stations are collected with the assistance of the various State and local health and milk sanitation agencies and shipped for analysis to either the Southwestern or Southeastern Radiological Health Facility. The Southeastern Radiological Health Facility processes samples from the 30 states generally east of the Mississippi, and the Southwestern Radiological Health Facility from the western states.

At the present time radioassays for Sr^{90} and Cs^{137} are being performed. As the laboratories increase their capacities and instrumentation, a selected group of radionuclides of concern to public health agencies will be included for assay as necessary for complete monitoring of the milk supply.

The data from the Southwestern Radiological Health Facility and the Southeastern Radiological Health Facility for June 1960 are presented in Table 2 and Table 3 respectively.

416

TABLE 1.–DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Robert A. Taft Sanitary Engineering Center

June 1960

(Radioactivity in $\mu\mu c$/liter)

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	June	Yearly average	June	Yearly average	June	Yearly average	June	Yearly average	June	Yearly average	June	Yearly average
Atlanta, Ga.	1.04	1.13	0	3	0	5	12.0	15.5	0	0	35	60
Austin, Tex.	1.02	1.09	0	2	0	2	2.6	5.0	0	0	25	28
Chicago, Ill.	1.14	1.09	0	0	0	3	12.6	9.8	0	0	30	43
Chicinnati, Ohio	1.22	1.12	0	0	0	3	10.0	11.0	0	0	15	33
New York, N. Y.	1.11	1.07	0	1	0	2	9.3	10.1	0	0	20	41
Overton, Nev.	1.10	1.08	0	0	0	0	2.3	3.2	0	0	5	21
Sacramento, Calif.	1.17	1.09	0	0	0	<1	4.3	3.6	0	0	5	23
Salt Lake City, Utah	1.11	1.10	0	0	0	2	7.2	7.2	0	0	25	42
Spokane, Wash.	1.04	1.12	0	0	0	5	17.3	12.6	0	0	35	56
St. Louis, Mo.	1.18	1.23	0	0	0	6	18.1	20.8	0	0	30	49

Samples are taken at one sampling point from the milk supply of the areas listed above.

417

79<

80<

TABLE 2.--DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southwestern Radiological Health Facility

June 1960

(Radioactivity in $\mu\mu c$/liter)

Area	Calcium grams/liter		Strontium-89		Strontium-90	
	June	Average to date	June	Average to date	June	Average to date
Albuquerque, New Mexico[4]	1.1	1.2	[5]0	0	5.6	4.1
Denver, Colorado	1.1	1.2	0	0	7.3	7.6
Des Moines, Iowa[1]	1.1	-	0	-	8.2	-
Helena, Montana[1]	1.0	-	0	-	8.9	-
Honolulu, Hawaii[3]	1.1	1.1	0	1.6	3.4	3.5
Idaho Falls, Idaho[4]	1.0	1.0	0	2.2	7.4	6.0
Kansas City, Missouri[3]	1.0	1.1	0	6.4	9.4	8.2
Laramie, Wyoming[3]	1.1	1.1	0	2.0	5.3	5.7
Las Vegas, Nevada[3]	1.1	1.1	0	0	2.8	2.8
Palmer, Alaska[4]	1.1	1.1	0	0	7.5	6.8
Portland, Oregon[3]	1.1	1.1	0	5.8	9.7	11.0
Salt Lake City, Utah[4]	1.1	1.1	0	0	5.4	7.4
San Francisco, California[1]	1.1	-	0	-	7.3	-
Seattle, Washington[3]	1.1	1.1	0	5.4	12.2	9.8
Spokane, Washington[2]	1.0	1.1	0	0	10.0	10.4
Wichita, Kansas[3]	1.1	1.1	0	3.9	6.6	6.6

[1] Initial Sample.
[2] Average includes two months.
[3] Average includes three months.
[4] Average includes four months.
[5] Zero means calculated value is less than twice error at 95% confidence level.

TABLE 3.–DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southeastern Radiological Health Facility

June 1960

(Radioactivity in $\mu\mu c$/liter)

Area	Calcium grams/liter		Strontium-90		Cesium-137	
	June	Yearly average	June	Yearly average	June	Yearly average
Austin, Tex.	1.16	-	2	-	20	-
Boston, Mass.	1.31	-	16	-	30	-
Buffalo, N. Y.	1.41	-	6	-	10	-
Burlington, Vt.	1.23	1.22	10	10	< 10	20
Charleston, W. Va.	1.26	1.21	11	9	< 10	10
Charlotte, N. C.	1.07	-	14	-	20	-
Dallas, Tex.	1.35	-	8	-	< 10	-
Hartford, Conn.	1.20	1.21	10	9	20	20
Louisville, Ky.	1.21	1.24	10	7	< 10	10
Manchester, N. H.	1.28	1.31	14	13	40	40
New York, N. Y.	1.24	-	11	-	20	-
Philadelphia, Pa.	1.25	-	10	-	30	-
Pittsburgh, Pa.	1.25	1.24	16	15	< 10	20
Portland, Maine	1.22	-	15	-	40	-
Providence, R. I.	1.29	-	18	-	20	-
Syracuse, N. Y.	1.36	1.28	8	7	< 10	20
Trenton, N. J.	1.26	-	10	-	20	0
Wilmington, Del.	1.26	-	10	-	40	-

Notes: Yearly average is average of April, May, and June values. Sr^{89} analysis performed, but no significant amounts detected.

82<

DATA ON RADIOACTIVITY IN MILK

Atomic Energy Commission Health and Safety Laboratory

The Atomic Energy Commission Health and Safety Laboratory conducts a routine milk monitoring program at four locations in the United States. Data for January, February and March 1960 were given in the Radiological Health Data August issue for three of the locations and in the October 1960 issue for the fourth. A list of publications for previous data may be found in the April 1960 issue.

TABLE 1.–STRONTIUM-90 AND CALCIUM IN AEC MILK SAMPLES

Sampling station location	Strontium-90			Calcium	
	μμc/liter (fluid)	μμc/kg (powdered)	μμc/gm Ca	gm/liter (fluid)	gm/kg (powdered)
Perry, N. Y.					
(Powdered milk)					
April		69.3	7.7		9.0
May		65.8	7.3		9.1
June		64.4	7.1		9.1
New York City					
(Liquid milk)					
April	9.3		8.7	1.1	
May	9.6		8.8	1.1	
June	11.0		10.1	1.1	
Mandan, S. Dak.					
(Powdered buttermilk)					
April		280	24.3		11.5
May		230	21.4		10.7
June		120	11.5		10.4
Honolulu, Hawaii					
(Liquid milk)					
April*	3.3		3.3	1.0	
	4.4		4.3	1.0	
May*	3.9		3.6	1.1	
	2.3		2.2	1.1	
June*	4.1		3.9	1.1	
	2.8		2.7	1.0	

*Two results per month represents milk from two different dairies.

SECRETION OF DIETARY STRONTIUM-90 AND CALCIUM IN HUMAN MILK *

Dr. S. Allan Lough, Director of the Atomic Energy Commission's Health and Safety Laboratory initiated a study in May 1959 on the secretion of strontium-90 in human milk. The five participants in the study were fed a known diet starting immediately postpartum. After a conditioning period of about 20 days, a five-day collection of food equivalent to that eaten, and a five-day collection of milk were obtained for analyses. The analyses for strontium-90 and calcium were conducted at the Health and Safety Laboratory and the data for the individual subjects are shown in Table 1.

The authors noted that subject 1 had an exceptionally high value of μμc Sr^{90}/gm Ca in her diet. This was apparently due to her large consumption of non-milk foods with a low calcium content.

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*Abstract from "Secretion of Dietary Strontium-90 and Calcium in Human Milk," S. Allan Lough, Gerald H. Hamada and C. L. Comar, Proceedings of the Society for Experimental Biology and Medicine, 1960, Vol. 104, page 194-198.

420

TABLE 1.–RESULTS ON HUMAN DIET AND MILK STUDY

Subjects:	I	II	III	IV	V
	Food Eaten				
1. Total wt eaten (gm)	14,780	13,800	15,390	12,380	13,220
2. Total ash (gm)	148.29	117.55	121.89	125.23	115.49
3. Ca as percent of total wt	0.03	0.06	0.07	0.06	0.05
4. gm Ca in 5-day sample	4.97	8.65	10.41	7.35	7.23
5. $\mu\mu$c Sr^{90} in 5-day sample	150.1 ± 4.3 *	127.9 ± 4.0	126.6 ± 3.4	138.9 ± 7.8	106.0 ± 1.7
6. $\mu\mu$c Sr^{90}/gm Ca	30.20 ± 0.76	14.79 ± 0.09	12.16 ± 0.25	18.90 ± 1.06	14.66 ± 0.99
	Milk Secreted				
7. Total weight (gm)	7,146	3,129	4,246	4,069	7,233
8. Total volume (ml)	6,930	3,030	4,140	3,940	7,000
9. Total ash (gm)	14.22	6.27	9.54	8.92	14.95
10. Ca as percent of total wt	0.023	0.023	0.023	0.027	0.028
11. $\mu\mu$c Sr^{90}/kg milk	0.19 ± 0.05 **	0.44 ± 0.16	0.23 ± 0.04	0.50 ± 0.10	0.36 ± 0.06
12. gm Ca in 5-day sample	1.640	0.709	0.985	1.088	2.018
13. $\mu\mu$c Sr^{90} in 5-day sample	1.36 ± 0.38	1.38 ± 0.51	1.01 ± 0.17	2.04 ± 0.40	2.59 ± 0.46
14. $\mu\mu$c Sr^{90}/gm Ca	0.83 ± 0.23	1.95 ± 0.72	1.03 ± 0.16	1.88 ± 0.37	1.28 ± 0.22
	Relation Between Food Eaten and Milk Secreted				
15. Ratio Sr^{90}/Ca Milk to Sr^{90}/Ca Diet	0.028	0.132	0.085	0.100	0.087

* Error term is one standard deviation from the mean of duplicate analyses.

** Error term is one standard deviation due to counting.

SECTION II.—AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout from nuclear weapons tests. Although no nuclear tests have been conducted by the United States since 1958, the program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 45 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to a laboratory in Washington for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 45 stations on an average of 70% of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85% of the stations collect samples of precipitation which are sent to Washington for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table 1 presents a summary of the data for June 1960.

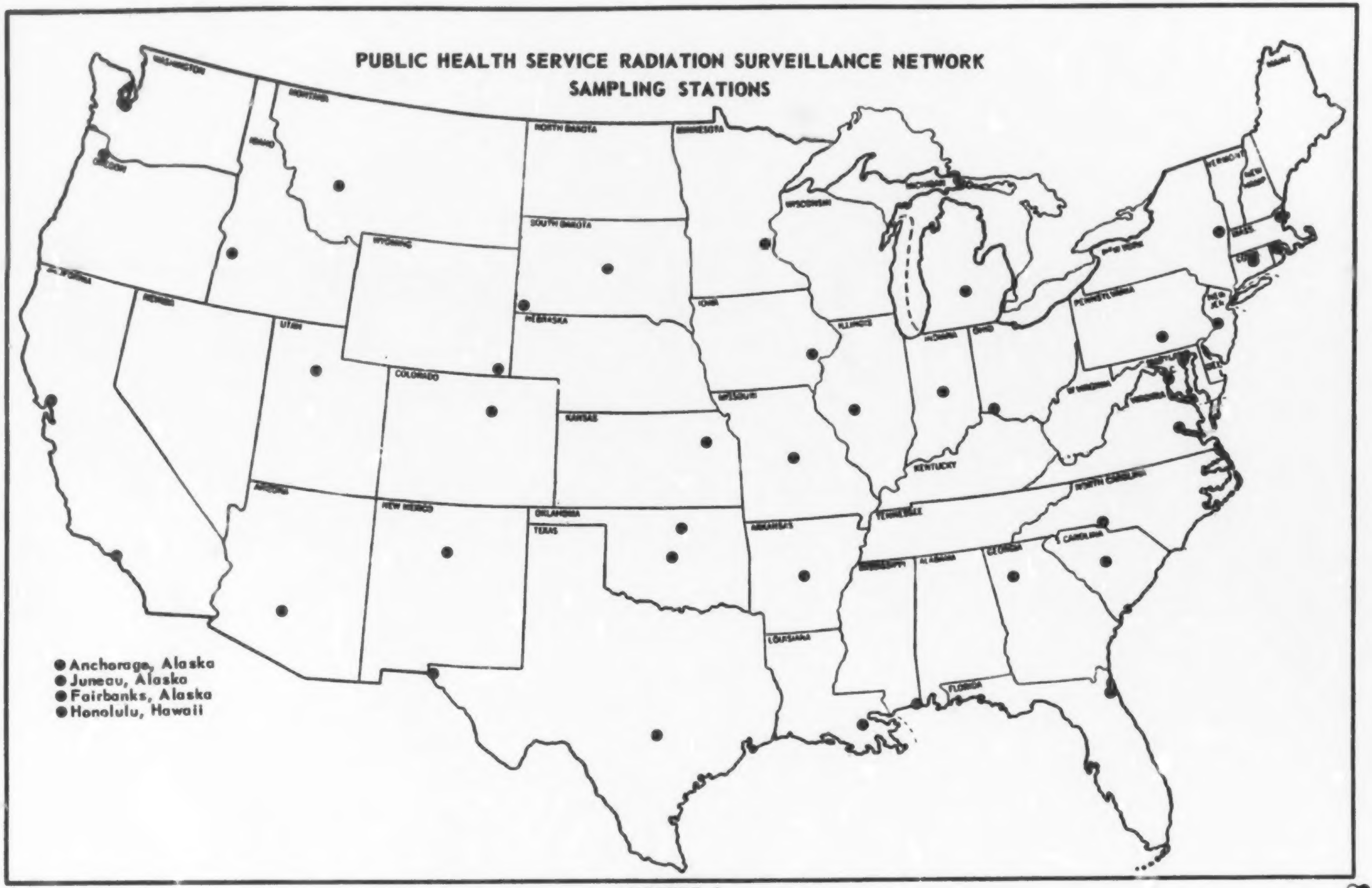

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK
SAMPLING STATIONS
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
PENNSYLVANIA
NEW YORK
VERMONT
NEW HAMP.
MAINE
MASS.
CONN.
NEW JER.
● Anchorage, Alaska
● Juneau, Alaska
● Fairbanks, Alaska
● Honolulu, Hawaii

FIGURE 1

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR-GROSS BETA COUNTS

Public Health Service Radiation Surveillance Network

June 1960

86<

Station location	Weighted average $\mu\mu c/m^3$	Maximum $\mu\mu c/m^3$	Minimum $\mu\mu c/m^3$
Alaska, Anchorage	< 0.11	0.17	< 0.10
Alaska, Fairbanks	< 0.14	0.23	< 0.10
Alaska, Juneau	< 0.10	0.16	< 0.10
Arizona, Phoenix	0.24	0.41	0.15
Arkansas, Little Rock	< 0.17	0.26	< 0.10
California, Berkeley	< 0.10	0.18	< 0.10
California, Los Angeles	< 0.10	0.11	< 0.10
Colorado, Denver	< 0.14	0.26	< 0.10
Connecticut, Hartford	< 0.15	0.30	< 0.10
District of Columbia	< 0.22	0.66	< 0.10
Florida, Jacksonville	< 0.15	0.32	< 0.10
Georgia, Atlanta	< 0.21	0.44	< 0.10
Hawaii, Honolulu	< 0.10	< 0.10	< 0.10
Idaho, Boise	0.21	0.34	0.12
Illinois, Springfield	< 0.21	0.42	< 0.10
Indiana, Indianapolis	< 0.16	0.31	< 0.10
Iowa, Iowa City	< 0.14	0.26	< 0.10
Kansas, Topeka	< 0.12	0.22	< 0.10
Louisiana, New Orleans	0.23	0.33	0.12
Maryland, Baltimore	< 0.18	0.26	< 0.10
Massachusetts, Lawrence	< 0.12	0.16	< 0.10
Michigan, Lansing	< 0.18	0.36	< 0.10
Minnesota, Minneapolis	< 0.16	0.29	< 0.10
Mississippi, Pascagoula	< 0.20	0.45	< 0.10
Missouri, Jefferson City	< 0.15	0.36	< 0.10
Montana; Helena	< 0.16	0.27	< 0.10
New Jersey, Trenton	< 0.22	0.33	< 0.10
New Mexico, Santa Fe	< 0.18	0.27	< 0.10
New York, Albany	< 0.14	0.28	< 0.10
North Carolina, Gastonia	< 0.19	0.29	< 0.10
Ohio, Cincinnati	0.85	2.30	0.30
Oklahoma, Oklahoma City	< 0.17	0.36	< 0.10
Oklahoma, Ponca City	< 0.10	0.14	< 0.10
Oregon, Portland	< 0.12	0.26	< 0.10
Pennsylvania, Harrisburg	< 0.20	0.41	< 0.10
Rhode Island, Providence	< 0.17	0.28	< 0.10
South Carolina, Columbia	< 0.18	0.34	< 0.10
South Dakota, Edgemont	-	-	-
South Dakota, Pierre	< 0.20	0.34	< 0.10
Texas, Austin	< 0.14	0.25	< 0.10
Texas, El Paso	0.21	0.25	0.13
Utah, Salt Lake City	< 0.17	0.28	< 0.10
Virginia, Richmond	< 0.14	0.23	< 0.10
Washington, Seattle	< 0.11	0.19	< 0.10
Wyoming, Cheyenne	< 0.14	0.23	< 0.10

424

TABLE 2.--RADON AND THORON MEASUREMENTS

Public Health Service Radiation Surveillance Network
Cincinnati, Ohio

June 1960

Date	Continuous sample collection			Radon[(a)] PM $\mu\mu c/m^3$	Radon[(b)] AM $\mu\mu c/m^3$	Thoron[(c)] $\mu\mu c/m^3$	Beta[(d)] activity $\mu\mu c/m^3$
	Sample change time	Sampling period (hours)	Volume m^3				
June 1	0812	24.0	28.7	72	530	5.0	1.7
2	0815	24.0	28.4	136	296	5.4	1.9
3	0808	23.8	28.3	110	200	2.8	0.3 (3)
6	0810	71.9	84.1	57	213	5.5	0.7
7	0811	24.0	28.7	63	374	6.6	2.3
8	0805	23.8	27.3	76	271	4.1	1.4
9	0812	24.0	28.9	91	277	4.0	1.5
10	0815	24.0	28.8	128	682	8.9	0.8 (3)
13	0811	71.9	85.4	147	182	3.2	0.3
14	0815	24.0	28.7	109	116	0.7	0.6
15	0807	23.8	28.6	43	72	0.9	0.5
16	0805	24.0	28.5	91	297	2.3	1.0
17	0807	24.1	28.8	81	212	0.9	0.3 (3)
20	0807	71.9	86.7	160	272	4.4	0.5
21	0810	24.0	28.9	158	247	3.5	1.3
22	0820	24.1	28.3	234	518	4.3	1.5
23	0810	23.8	28.7	40	46	0.7	0.5
24	0812	24.0	28.9	92	112	0.9	0.3 (3)
27	0810	71.9	85.0	131	643	7.3	1.0
28	0810	23.9	28.8	61	178	1.9	0.6
29	0810	23.9	28.5	70	144	1.1	0.3
30	0825	24.2	28.7	257	169	3.7	1.1
	Average...............................			108	282	3.5	0.8

(a) Filters are temporarily withdrawn from sampler at about 3 PM and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 AM the following day.

(b) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(c) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

(d) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

88<

PUBLIC HEALTH SERVICE NATIONAL AIR SAMPLING NETWORK

The Public Health Service developed its National Air Sampling Network to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, climate, and other factors associated with air quality.

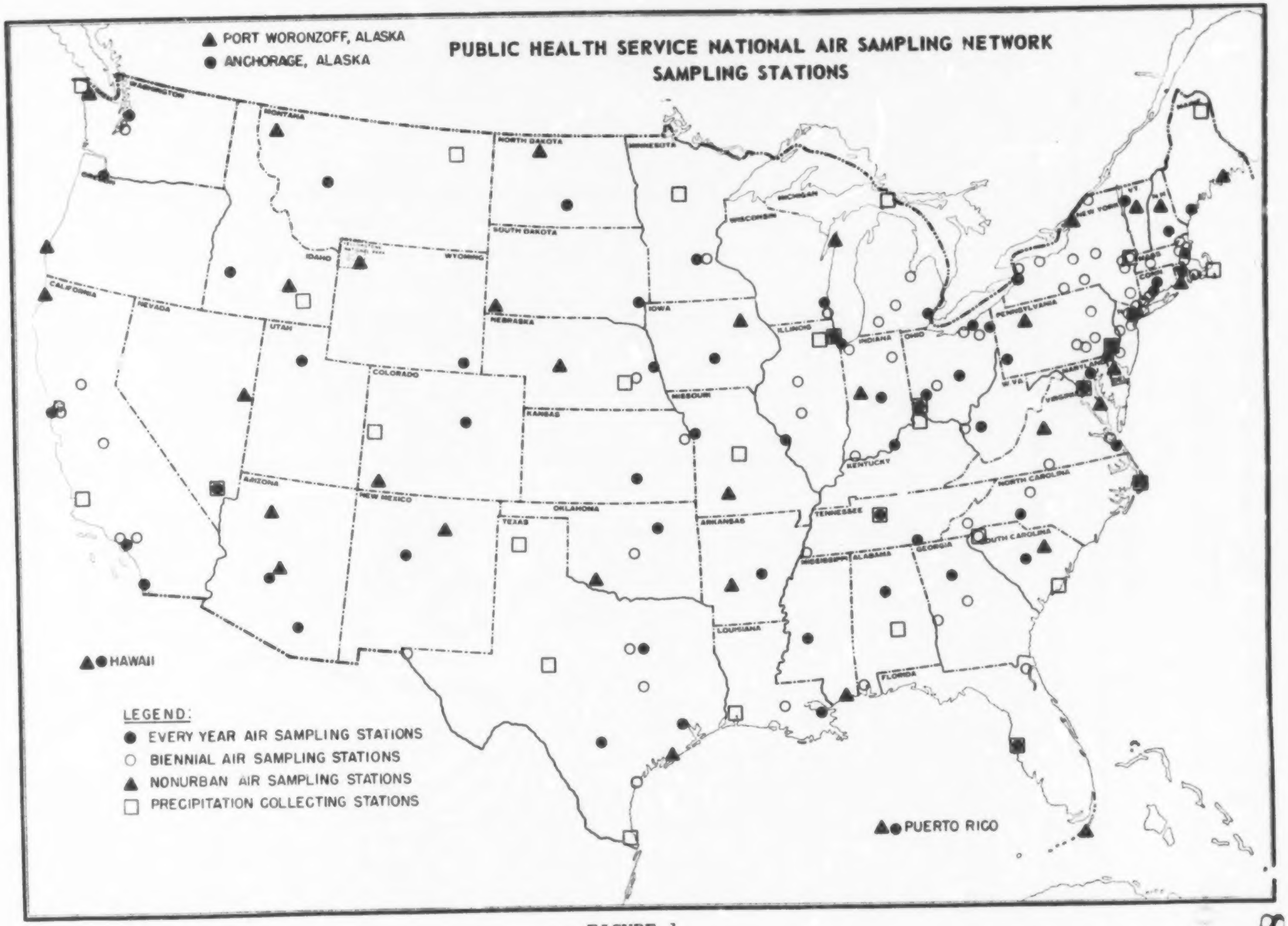
The current basic Network, which is operated by the PHS Division of Air Pollution, consists of 103 sampling stations operating every year, of which 66 are in large cities and 37 are in nonurban areas. In addition to these every year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Network Stations appeared in the May 1960 issue of Radiological Health Data.

The Network stations are manned by cooperating federal, state, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2,000 cubic meters of air are collected on glass fiber filters on a bi-weekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

Quarterly reports of individual sample data and annual summaries are distributed to all participating agencies and state health departments. A comprehensive report on the first five years of operation of the Network is contained in the publication, Air Pollution Measurements of the National Air Sampling Network, Public Health Service Publication No. 637, 1958; for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price $2.00. Gross beta activity, by States, for the years 1953 through 1958 was submitted by Dr. F. J. Weber, Chief of the Division of Radiological Health Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 173-185.

The 1959 quarterly and yearly averages of the gross beta activity of particulates in air were published in the October 1960 Radiological Health Data. Table 1 presents the data for the first two quarters of 1960.

426



PUBLIC HEALTH SERVICE NATIONAL AIR SAMPLING NETWORK
SAMPLING STATIONS

▲ PORT WORONZOFF, ALASKA
● ANCHORAGE, ALASKA
▲● HAWAII
▲● PUERTO RICO
LEGEND:
● EVERY YEAR AIR SAMPLING STATIONS
○ BIENNIAL AIR SAMPLING STATIONS
▲ NONURBAN AIR SAMPLING STATIONS
☐ PRECIPITATION COLLECTING STATIONS
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
W. VA.
PENNSYLVANIA
NEW YORK
MARYLAND
CONN.
MASS.
VT.
N.H.
MAINE

FIGURE 1

90<

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR

National Air Sampling Network
Public Health Service

1960

(picocuries per cubic meter)

Station	First quarter		Second quarter	
	No. samples	Average **	No. samples	Average **
Bridgeport, Conn.	6	0.1	6	0.1
Hartford, Conn.	7	0.1	6	0.1
New Haven, Conn.	7	0.1	6	0.1
Stamford, Conn.	7	0.1	6	0.2
Portland, Maine	5	0.1	7	0.1
*Acadia National Park, Maine	7	0.1	6	0.1
Boston, Mass.	7	0.1	6	0.1
Lawrence, Mass.	7	0.1	6	0.1
Lynn, Mass.	6	0.1	7	0.1
Fall River, Mass.	5	0.1	3	0.1
Quincy, Mass.	7	0.1	5	0.2
Springfield, Mass.	2	0.1	6	0.1
Somerville, Mass.	7		6	0.1
Manchester, N. H.	6		6	0.1
*Coos County, N. H.	6	0.1	6	0.1
Providence, R. I.	7	0.1	6	0.1
*Washington County, R. I.	7	0.1	6	0.1
Burlington, Vt.	5	0.1	7	0.1
*Orange County, Vt.	5		7	0.1
Wilmington, Del.	6	0.1	6	0.2
*Kent County, Del.	1	0.2	7	0.1
Elizabeth, N. J.	4	0.1	7	0.1
Camden, N. J.	7	0.1	6	0.1
Trenton, N. J.	4	0.1	4	0.2
East Orange, N. J.	5	0.1	4	0.1
Newark, N. J.	7	0.1	6	0.1
New York, N. Y.	7	0.1	5	0.1
Binghamton, N. Y.	5	0.1	6	0.1
Albany, N. Y.	5	0.1	8	
Schenectady, N. Y.	7	0.1	5	0.1
Syracuse, N. Y.	6	0.1	7	0.1
Utica, N. Y.	7		6	0.1
Rochester, N. Y.	7	0.1	6	0.1
Niagara Falls, N. Y.	5	0.1	5	0.1
New Rochelle, N. Y.	6	0.1	7	0.1
Troy, N. Y.	6	0.1	4	0.1
Massena, N. Y.	7		5	0.1
Glen Cove, N. Y.	7	0.1	5	
Elmira, N. Y.	7	0.1	6	0.1
Mt. Vernon, N. Y.	1	0.1	6	0.1
*Cape Vincent, N. Y.	3	0.1	6	0.1
Philadelphia, Pa.	6		7	0.1
Pittsburgh, Pa.	7	0.1	4	0.1
Lancaster, Pa.	2	0.1	4	0.1
Harrisburg, Pa.	6	0.1	6	0.1
Reading, Pa.	6	0.1	7	0.1
Wilkes-Barre, Pa.	7	0.1	6	0.1
*Clarion County, Pa.	7	0.1	6	0.1
Washington, D. C.	5	0.2	6	0.2
Louisville, Ky.	4	0.2	2	0.1
Baltimore, Md.	7	0.1	5	0.2

1 picocurie = 1 micromicrocurie.

428

TABLE 1.–GROSS BETA RADIOACTIVITY IN AIR–Con.

National Air Sampling Network
Public Health Service

1960

(picocuries per cubic meter)

Station	First quarter		Second quarter	
	No. samples	Average **	No. samples	Average**
* Calvert County, Md.	7	0.1	6	0.1
Charlotte, N. C.	6	0.1	7	0.2
Winston-Salem, N. C.	7	0.2	6	0.2
Ashville, N. C.	7	0.2	6	0.2
* Cape Hatteras, N. C.	6	0.1	5	0.1
San Juan, P. R.	3	0.5	7	0.1
* Loquillo Mtns. Pk., P. R.	6	0.1	6	0.1
Norfolk, Va.	6	0.1	7	
Hampton, Va.	7	0.1	6	0.2
Danville, Va.	7	0.1	6	0.2
* Shenandoah National Park, Va.	7	0.1	6	0.2
Charleston, W. Va.	7	0.1	6	0.2
Huntington, W. Va.	6	0.1	5	0.1
Birmingham, Ala.	6	0.1	6	0.2
Mobile, Ala.	7	0.1	5	0.1
Tampa, Fla.	7	0.3	6	0.2
Jacksonville, Fla.	7	0.2	6	0.2
* Florida Keys, Fla.	5	0.1	7	0.1
Atlanta, Ga.	7	0.2	6	0.1
Columbus, Ga.	7	0.2	6	0.2
Macon, Ga.	7	0.1	6	0.1
Jackson, Miss.	6	0.1	6	0.2
* Jackson County, Miss.	7	0.1	6	0.1
Columbia, S. C.	6	0.1	7	0.2
Greenville, S. C.	6	0.2	6	0.2
* Richland County, S. C.	6	0.1	7	0.2
Chattanooga, Tenn.	7	0.1	6	0.2
Nashville, Tenn.	6	0.2	7	0.1
Memphis, Tenn.	7	0.1	6	0.2
Chicago, Ill.	5	0.1	4	0.1
Springfield, Ill.	4	0.2	4	0.1
Peoria, Ill.	4	0.1	5	0.2
East Chicago, Ind.	7	0.1	5	0.1
Evansville, Ind.	7	0.2	6	0.2
Fort Wayne, Ind.	7		6	0.1
Indianapolis, Ind.	6	0.1	7	0.2
Gary, Ind.	6	0.1	6	0.1
* Montgomery County, Ind.	7	0.1	6	0.1
Detroit, Mich.	7	0.1	6	0.1
Kalamazoo, Mich.	6	0.1	7	0.1
Lansing, Mich.	6		6	
Saginaw, Mich.	6	0.1	7	0.1
Cincinnati, Ohio	7	0.1	5	0.1
Youngstown, Ohio	7	0.1	6	0.1
Cleveland, Ohio	6	0.1	7	0.1
Columbus, Ohio	6	0.1	6	0.1
Lorain, Ohio	7	0.1	6	0.1
Akron, Ohio	7	0.1	6	0.1
Dayton, Ohio	7	0.1	6	0.1
Springfield, Ohio	6	0.1	7	0.1
Milwaukee, Wis.	6	0.1	6	0.1

1 picocurie = 1 micromicrocurie.

92<

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR—Con.

National Air Sampling Network
Public Health Service

1960

(picocuries per cubic meter)

Station	First quarter		Second quarter	
	No. samples	Average **	No. samples	Average **
Racine, Wis.	6	0.1	6	0.1
* Door County, Wis.	6	0.1	7	0.1
Des Moines, Iowa	7	0.2	5	0.2
* Clayton County, Iowa	7	0.1	6	0.1
Kansas City, Kansas	7	0.1	6	0.1
Wichita, Kansas	5	0.1	6	0.3
Minneapolis, Minn.	7	0.1	6	0.1
St. Paul, Minn.	7	0.1	5	0.1
Kansas City, Mo.	7	0.1	6	0.1
St. Louis, Mo.	7	0.1	6	0.2
* Shannon County, Mo.	4	0.1	3	0.2
Omaha, Nebr.	7	0.1	6	0.1
Lincoln, Nebr.	7	0.1	7	0.1
* Thomas County, Nebr.	6	0.1	7	0.2
Bismarck, N. D.	5		7	0.1
* Ward County, N. D.	5	0.1	5	0.1
Sioux Falls, S. D.	4	0.1	6	0.2
* Black Hills Forest, S. D.	5	0.1	6	0.1
Little Rock, Ark.	7	0.1	6	0.2
* Montgomery County, Ark.	7	0.1	6	0.2
New Orleans, La.	7	0.1	6	0.1
Baton Rouge, La.	7	0.2	6	0.2
Alburquerque, N. Mex.	6	0.2	6	0.2
* Colfax County, N. Mex.	6	0.1	5	0.1
Tulsa, Okla.			7	0.2
Oklahoma City, Okla.	6	0.1	4	0.2
* Cherokee County, Okla.	6	0.2	5	0.2
Ft. Worth, Texas	6	0.1	7	0.2
Houston, Texas	7	0.2	6	0.2
Dallas, Texas	7	0.1	5	0.2
San Antonio, Texas	6	0.2	6	0.1
El Paso, Texas	7	0.3	6	0.2
Corpus Christi, Texas	7	0.1	6	0.2
Waco, Texas	7	0.1	6	0.1
* Calhoun County, Texas	5	0.1	2	0.2
Denver, Colo.	7	0.1	6	0.2
* Montezuma County, Colo.	7	0.3	5	0.3
Boise, Idaho	7	0.3	5	0.1
* Butte County, Idaho	6	0.1	6	0.1
Helena, Mont.	6	0.1	6	0.1
* Glacier National Park, Mont.	6	0.1	6	0.1
Salt Lake City, Utah	6	0.3	[illegible]	0.2
Cheyenne, Wyo.	6	0.1	7	0.1
* Yellowstone Park, Wyo.	4	0.1	3	0.2
Anchorage, Alaska	7	0.1	6	
* Pt. Woronzof, Alaska	6	0.1	7	0.1
Phoenix, Ariz.	7	0.2	5	0.2
Tucson, Ariz.	6	0.5	7	0.3
* Maricopa County, Ariz.	7	0.2	6	0.3
* Grand Canyon Park, Ariz.	4	0.2	7	0.2
Los Angeles, Calif.	6	0.2	7	0.1

1 picocurie = 1 micromicrocurie.

430

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR--Con.

National Air Sampling Network
Public Health Service

1960

(picocuries per cubic meter)

Station	First quarter		Second quarter	
	No. samples	Average **	No. samples	Average **
San Francisco, Calif.	7	0.1	6	0.1
Pasadena, Calif.	7	0.1	6	0.1
San Diego, Calif.	7	0.2	6	
Burbank, Calif.	6	0.3	7	0.1
Fresno, Calif.	7	0.2	6	0.2
Oakland, Calif.	6	0.1	6	
Sacramento, Calif.	6	0.3	7	0.1
Richmond, Calif.	5	0.3	6	0.2
* Humboldt County, Calif.	6	0.1	5	
Honolulu, Hawaii	7	0.1	6	0.1
* Ewa County, Hawaii	6	0.2	7	
Las Vegas, Nevada	3	0.3	6	0.3
* White Pine County, Nevada	7	0.2	6	0.2
Portland, Oregon	7	0.1	6	
* Curry County, Oregon	7	0.1	5	0.1
Seattle, Washington	3	0.1		
Tacoma, Washington	3	0.2	5	
* Clallam County, Washington			3	

* Nonurban station.

** A blank space in the table indicates that the level was below the minimum detectable value of 0.1 pc/m^3.

GROSS BETA RADIOACTIVITY IN PRECIPITATION

National Air Sampling Network
Precipitation Collection Section
Public Health Service

During 1959 a precipitation collection and analysis program was established by the Weather Bureau Research Station in Cincinnati, Ohio, and the National Air Sampling Network. The collection stations are located at Weather Bureau Offices or Airport Stations. Monthly composite samples of precipitation are collected at 29 stations and forwarded to the Network laboratory for analysis. A list of these precipitation collection stations is given below. Samples are analyzed for total solids and a large number of metals and nonmetals. In addition, samples representing 85% or more of the official rainfall recorded at the collecting stations are analyzed for gross beta radioactivity if a large enough volume remains after the needs for the chemical analysis have been met.

Quarterly data on gross beta radioactivity of precipitation will be published in the *Radiological Health Data* Quarterly Reports. Tables 1 presents the data for the first two quarters of 1960.

94<

PRECIPITATION COLLECTION STATIONS

National Air Sampling Network

Alabama: Montgomery
California: Santa Marie
Colorado: Grand Junction
Florida: Tampa
Idaho: Pocatello
Illinois:
  Chicago (Midway Airport)
  Chicago (O'Hare Airport)
Louisiana: Lake Charles
Maine: Caribou
Maryland: Silver Hill
Massachusetts: Nantucket
Michigan: Sault Ste. Marie
Minnesota: St. Cloud
Missouri: Columbia
Montana: Glasgow
Nebraska: Grand Island
Nevada: Las Vegas
New York: Albany
North Carolina: Cape Hatteras
Ohio:
  Cincinnati (Research Station)
  Cincinnati (Airport)
Pennsylvania: Philadelphia
South Carolina:
  Carleston
  Greenville
Tennessee: Nashville
Texas:
  Brownsville
  San Angelo
  Amarillo
Washington: Tatoosh Island

TABLE 1.–GROSS BETA RADIOACTIVITY OF PRECIPITATION

National Air Sampling Network
Public Health Service

First and second quarter 1960

Station location	January		February		March		April		May		June	
	pc/l	pc/m^2	pc/l	pc/m^2	pc/l	pc/m^2	pc/l	pc/m^2	pc/l	pc/m^2	pc/l	pc/m^2
Albany, New York	-	-	-	-	-	-	-	-	-	-	24	1,500
Brownsville, Texas	-	-	-	-	-	-	-	-	-	-	34	2,500
Cape Hatteras, N.C.	3	500	-	-	35	4,500	12	1,500	-	-	20	3,300
Caribou, Maine	-	-	9	800	26	1,600	-	-	28	2,200	-	-
Charleston, W. Va.	-	-	42	4,200	-	-	-	-	-	-	25	2,800
Chicago, Illinois (Midway Airport)	19	1,500	-	-	-	-	-	-	-	-	-	-
Chicago, Illinois (O'Hare Airport)	16	1,300	-	-	-	-	-	-	-	-	-	-
Cincinnati, Ohio (Airport)	13	700	-	-	-	-	-	-	41	3,300	-	-
Cincinnati, Ohio (WBRS)	-	-	-	-	-	-	-	-	-	-	41	5,200
Columbia, Missouri	12	400	-	-	-	-	-	-	-	-	12	1,000
Grand Island, Nebr.	-	-	-	-	-	-	39	2,600	-	-	-	-
Lake Charles, La.	-	-	-	-	-	-	47	7,500	-	-	-	-
Montgomery, Ala.	-	-	24	2,100	33	4,200	-	-	14	1,100	-	-
Nashville, Tenn.	-	-	-	-	-	-	35	2,600	51	3,600	31	7,800
Philadelphia, Penna.	-	-	-	-	-	-	-	-	65	5,200	-	-
Sault Ste. Marie, Mich.	-	-	-	-	-	-	-	-	36	5,000	-	-
Tampa, Florida	-	-	39	3,200	24	11,100	-	-	-	-	-	-
Washington, D.C.	37	2,200	-	-	-	-	33	2,500	38	4,200	-	-

pc = picocuries = micromicrocuries.
- No data available due to low counting efficiency or inadequate sample.

432

U. S. NAVAL RESEARCH LABORATORY RADIOACTIVITY MEASUREMENTS

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during June 1960 is shown in Table 1, while the radioactivity profile for the same month is shown in Figure 1. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site. (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter)

TABLE 1.—DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION

U.S. Naval Research Laboratory

June 1960

(Disintegrations/minute per cubic meter of air)

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador
1	-	0.04	0.13	0.07	0.05	0.06	0.03
2	-	0.03	0.08	0.07	0.05	0.06	0.07
3	-	0.03	0.08	0.07	0.05	0.06	0.07
4	-	0.04	0.11	0.08	0.04	0.02	0.07
5	-	0.04	0.11	0.08	0.04	0.02	0.06
6	-	0.04	0.11	0.08	0.04	0.02	0.06
7	-	0.02	0.09	0.08	0.05	0.04	0.07
8	-	0.02	0.09	0.08	0.05	0.04	0.05
9	-	0.02	0.06	0.07	0.05	0.06	0.04
10	-	0.01	0.06	0.07	0.05	0.06	0.04
11	-	0.01	0.10	0.05	0.06	0.04	0.04
12	-	0.07	0.10	0.05	0.06	0.04	0.04
13	-	0.07	0.10	0.05	0.06	0.04	0.07
14	-	0.03	0.07	0.08	0.04	0.03	0.08
15	-	0.03	0.07	0.08	0.04	0.03	0.08
16	-	0.03	0.07	0.07	0.05	0.03	0.07
17	-	0.03	0.07	0.07	0.05	0.03	0.07
18	-	0.03	0.06	0.05	0.06	0.01	0.04
19	-	0.01	0.06	0.05	0.06	0.01	0.04
20	-	0.01	0.06	0.05	0.06	0.01	0.04
21	-	0.07	0.06	0.05	0.03	0.03	0.04
22	-	0.07	0.06	0.05	0.03	0.03	0.07
23	-	0.06	0.02	0.02	0.03	0.06	0.04
24	-	0.06	0.02	0.02	0.03	0.06	0.04
25	-	0.01	0.06	0.10	0.03	0.03	0.04
26	-	0.01	0.06	0.10	0.03	0.03	0.04
27	-	0.01	0.06	0.10	0.03	0.03	0.05
28	-	0.03	0.07	0.13	0.03	0.02	0.06
29	-	0.03	0.07	0.13	0.03	0.02	0.06
30	-	0.02	0.07	0.07	0.05	0.02	0.03
Mean value	-	0.03	0.07	0.07	0.04	0.03	0.05

96<

TABLE 1.—DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION—Con.

U.S. Naval Research Laboratory

June 1960

(Disintegrations/minute per cubic meter of air)

Day	Miraflores, Panama Canal	Mauna Loa, Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland	Bravo*, Arctic Ice Floe
1	0.03	0.36	0.14	0.50	0.25	0.25	-
2	0.01	0.20	0.11	0.76	0.45	0.56	-
3	0.01	0.20	0.11	0.76	0.45	0.56	-
4	0.01	0.03	0.10	0.36	0.24	0.41	-
5	0.01	0.03	0.10	0.36	0.24	0.41	-
6	0.01	0.03	0.10	0.36	0.24	0.41	-
7	0.02	0.17	0.10	0.42	0.26	0.06	-
8	0.02	0.17	0.10	0.42	0.26	0.06	-
9	0.01	0.12	0.06	0.73	0.53	0.08	-
10	0.01	0.12	0.06	0.73	0.53	0.08	-
11	0.03	0.33	0.83	0.47	0.20	0.36	-
12	0.03	0.33	0.83	0.47	0.20	0.36	-
13	0.03	0.33	0.83	0.47	0.20	0.36	-
14	0.07	0.34	0.43	0.35	0.62	0.36	-
15	0.07	0.34	0.43	0.35	0.62	0.12	-
16	0.05	0.32	0.12	0.49	0.14	0.12	-
17	0.05	0.32	0.12	0.49	0.14	0.12	-
18	0.03	0.32	0.12	0.35	0.47	0.12	-
19	0.03	0.32	0.12	0.35	0.47	0.14	-
20	0.03	0.32	0.12	0.35	0.47	0.14	-
21	0.05	0.35	0.17	0.39	0.35	0.08	-
22	0.05	0.35	0.17	0.39	0.35	0.08	-
23	0.05	0.08	0.22	0.30	0.41	0.08	-
24	0.05	0.08	0.22	0.30	0.41	0.08	-
25	0.03	0.21	0.30	0.59	0.47	0.10	-
26	0.03	0.21	0.30	0.59	0.47	0.10	-
27	0.03	0.21	0.30	0.59	0.47	0.10	-
28	0.03	0.18	0.25	0.65	0.50	0.15	-
29	0.03	0.18	0.25	0.65	0.50	0.15	-
30	0.04	0.64	0.22	0.50	0.34	-	-
Mean value	0.03	0.24	0.24	0.48	0.38	0.21	-

* No sample received.

434

AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS ALONG THE 80TH MERIDIAN (WEST)

U. S. Naval Research Laboratory

June 1960

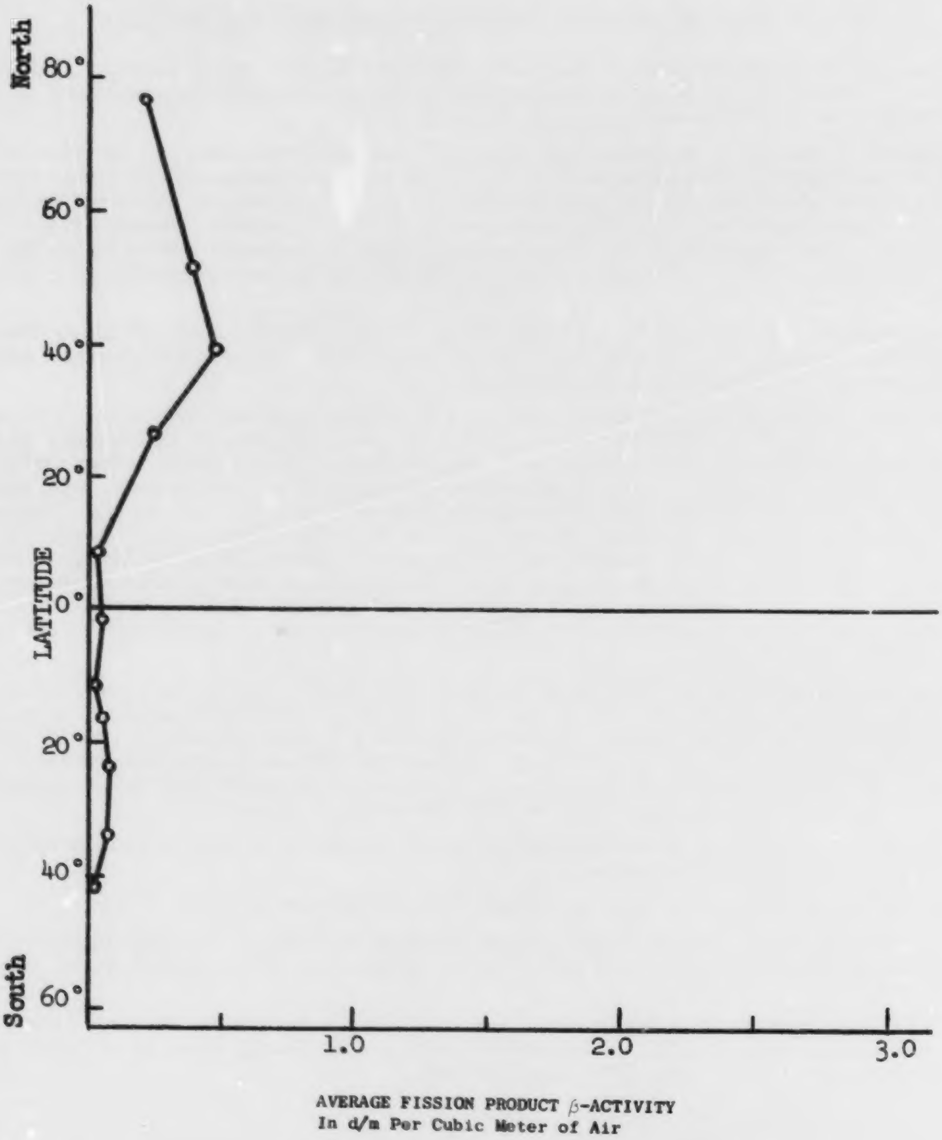


FIGURE 1

98<

SECTION III.—WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provision of Section 4 (c) of Public Law 660, which states ". . . the Surgeon General shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. At present there are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing, beta activity in most raw waters is generally approaching a level attributable solely to natural beta activity. Natural beta activity can be two or three times the natural alpha activity based on the same nuclides being present. Some exceptions to this are seen, notably the data for the Columbia River and the Animas River. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than one week. Beginning with samples taken in January 1960, beta determinations were performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

Strontium-90 data are reported as being the results of determinations on composite samples for a three-month period ending in the month shown.

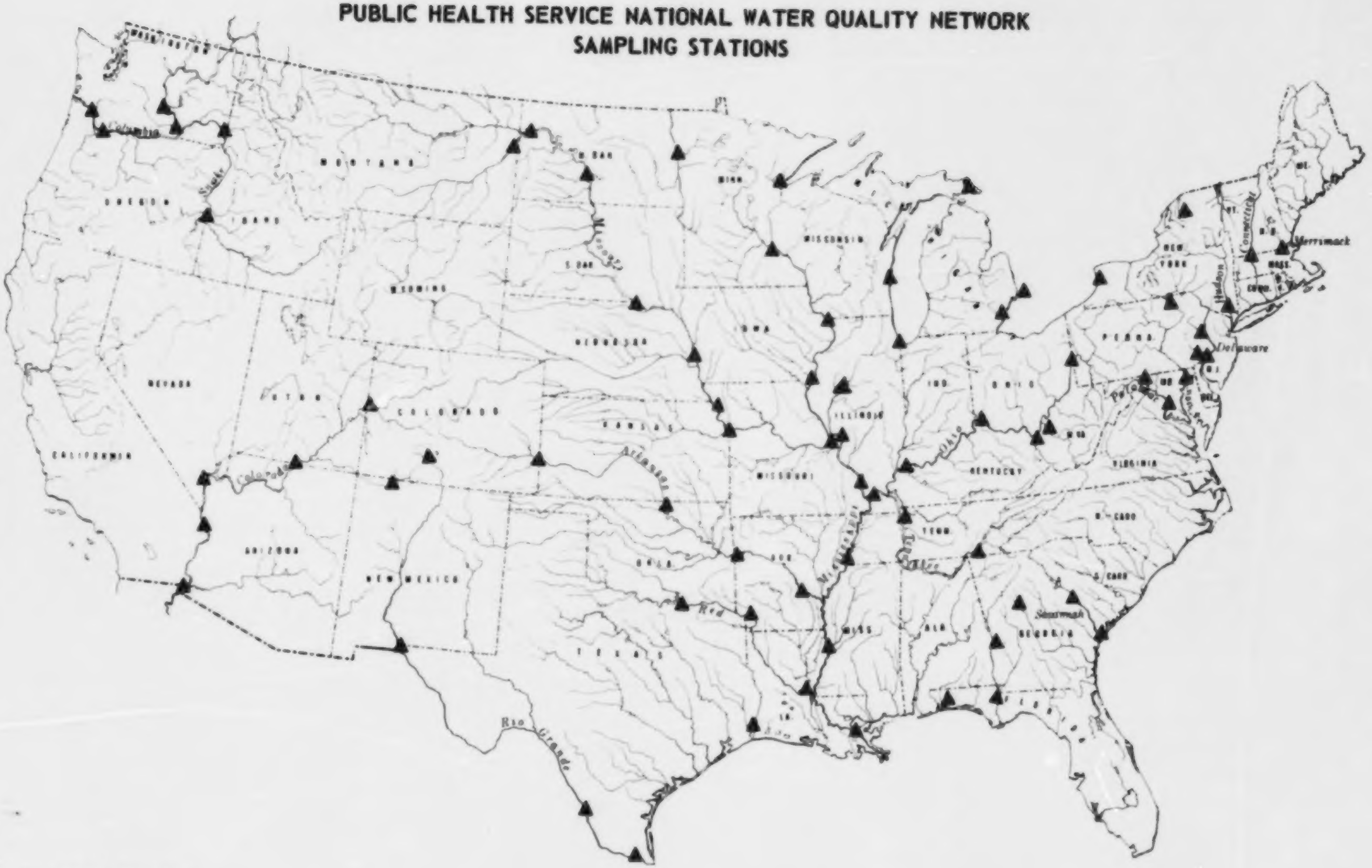
Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167-169.

436

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS


WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
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COLORADO
ARIZONA
NEW MEXICO
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NEBRASKA
KANSAS
OKLA
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TENN
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ALA
GEORGIA
FLORIDA
S CARO
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VIRGINIA
W VA
PENNA
NEW YORK
VT
N.H.
ME
MASS
CONN
N.J.
MD
Columbia
Snake
Missouri
Colorado
Arkansas
Red
Rio Grande
Mississippi
Ohio
Tennessee
Potomac
Delaware
Hudson
Connecticut
Merrimack
Savannah

As of June 30, 1960

FIGURE 1

437

99<

100<

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending 3/31/60	May, 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ALSEA RIVER							
Alsea, Oreg.	0.1	0	0	0	-	-	-
ANIMAS RIVER							
Cedar Hill, N. Mex.	0.5	7	3	10	6	6	12
APALACHICOLA RIVER							
Chattahoochie, Fla.	-	0	0	0	0	0	0
ARKANSAS RIVER							
Coolidge, Kans.	1.2	4	0	4	8	29	37
Ponca City, Okla.	0.9	38	13	51	30	4	34
Fort Smith, Ark.	-	15	0	15	11	1	12
Pendleton Ferry, Ark.	0.8	55	5	60	14	2	16
CHATTAHOOCHIE RIVER							
Columbus, Ga.	0.5	0	<1	<1	0	0	0
COLORADO RIVER							
Loma, Colo.	0.1	5	35	40	3	5	8
Page, Ariz.	0.2	43	13	56	16	4	20
Hoover Dam, Ariz.-Nev.	0.7	0	14	14	0	8	8
Parker Dam, Ariz.-Calif.	0.3	0	0	0	<1	8	8
Yuma, Ariz.	0.3	0	5	5	<1	6	6
COLUMBIA RIVER							
Pasco, Wash.	0.6	40	282	322	0	0	0
Wenatchee, Wash.	0.4	-	-	-	-	-	-
Bonneville Dam, Ore.	0.3	29	105	134	0	0	0
Clatskanie, Oreg.	0.1	18	107	125	-	-	-
CONNECTICUT RIVER							
Northfield, Mass.	-	0	0	0	0	0	0
DELAWARE RIVER							
Martin's Creek, Pa.	0.6	0	0	0	0	0	0
Philadelphia, Pa.	0.9	0	<1	<1	0	0	0
GREAT LAKES							
Gary, Ind.	0.5	0	0	0	0	0	0
Duluth, Minn.	0.2	0	0	0	0	0	0
Detroit, Mich.	0.3	0	2	2	0	0	0
Buffalo, N. Y.	0.9	0	0	0	0	0	0
HUDSON RIVER							
Poughkeepsie, N. Y.	1.7	0	0	0	0	0	0

TABLE 1.--RADIOACTIVITY IN RAW SURFACE WATERS--Con.
Public Health Service National Water Quality Network
(Micromicrocuries per liter)

Station	Quarter ending 3/31/60	May, 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ILLINOIS RIVER							
Peoria, Ill.		0	1	1	<1	2	2
KANAWHA RIVER							
Winfield Dam, W. Va.	0.2	0	0	0	0	0	0
MERRIMACK RIVER							
Lowell, Mass.	0.5	-	-	-	-	-	-
MISSISSIPPI RIVER							
Red Wing, Minn.	0.7	2	2	4	0	3	3
Dubuque, Iowa	1.4	0	0	0	-	-	-
Burlington, Iowa	1.0	0	42	42	0	0	0
East St. Louis, Ill.	0.5	1	1	2	1	3	4
Cape Girardeau, Mo.	0.4	14	12	26	-	-	-
West Memphis, Ark.	1.3	0	<1	<1	0	1	1
Delta, La.	1.0	8	2	10	3	0	3
New Orleans, La.	0.9	26	10	36	8	2	10
MISSOURI RIVER							
Williston, N. D.	-	0	4	4	0	3	3
Bismarck, N. D.	0.5	0	0	0	1	1	2
Yankton, S. D.	1.7	0	11	11	0	5	5
Omaha, Nebr.	0.4	14	9	23	7	5	12
St. Joseph, Mo.	0.9	32	10	42	8	5	13
Kansas City, Kans.	0.5	31	7	38	6	0	6
St. Louis, Mo.	0.9	40	24	64	16	5	21
OHIO RIVER							
East Liverpool, O.	0.5	0	7	7	0	0	0
Huntington, W. Va.	0.2	0	0	0	1	0	1
Cincinnati, O.	0.4	<1	<1	1	0	0	0
Evansville, Ind.	0.7	0	2	2	0	0	0
Cairo, Ill.	0.6	0	0	0	0	0	0
POTOMAC RIVER							
Williamsport, Md.	0.3	11	0	11	9	0	9
Great Falls, Md.	0.6	0	4	4	0	0	0
RED RIVER							
Denison, Tex.	1.4	0	2	2	1	0	1
Index, Ark.	0.7	3	0	3	8	0	8
Alexandria, La.	1.3	3	7	10	4	1	5
RIO GRANDE RIVER							
El Paso, Tex.	-	1	0	1	2	6	8
Laredo, Tex.	0.1	0	0	0	0	1	1
Brownsville, Tex.	0.6	-	-	-	-	-	-

102<

TABLE 1.--RADIOACTIVITY IN RAW SURFACE WATERS--Con.

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending 3/31/60	May, 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
SABINE RIVER							
Ruliff, Tex.	-	0	4	4	0	0	0
ST. CLAIR RIVER							
Port Huron, Mich.	-	0	0	0	0	0	0
ST. LAWRENCE RIVER							
Massena, N. Y.	-	0	0	0	0	0	0
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.3	0	0	0	0	1	1
SCHUYLKILL RIVER							
Philadelphia, Pa.	0.5	0	0	0	0	0	0
SAVANNAH RIVER							
Port Wentworth, Ga.	0.2	<1	29	29	<1	0	<1
SNAKE RIVER							
Wawawai, Wash.	0.3	0	<1	<1	0	0	0
Weiser, Idaho	-	<1	4	5	0	3	3
SUSQUEHANNA RIVER							
Sayre, Pa.	-	0	0	0	0	0	0
Conowingo, Md.	-	2	4	6	<1	<1	<1
TENNESSEE RIVER							
Chattanooga, Tenn.	0.4	0	81	81	0	1	1
YELLOWSTONE RIVER							
Sidney, Mont.	1.2	0	2	2	1	3	4

440

MONITORING OF WATER SUPPLIES AROUND THE NEVADA TEST SITE

By contract with the Atomic Energy Commission the Public Health Service has conducted an off-site monitoring program around the Nevada Test Site since 1955. Included in the program have been measurements of radioactivity in water supplies. These data have been reported in the Atomic Energy Commission's 13th, 14th, 18th and 23rd Semiannual Reports to Congress and by the Public Health Service in the 1957 Congressional Hearings, "The Nature of Radioactive Fallout and Its Effects on Man."

Table 1 gives a brief description of each water sampling point. The map in Fig. 1 summarizes the data on gross beta radioactivity in water supplies for the two-month period, May-June 1960.

The lower limit of detectability with the equipment used is about 10^{-8} microcuries per milliliter (10 micromicrocuries per liter).

TABLE 1.—DESCRIPTION OF WATER SAMPLING POINTS

Nevada Test Site

Location	Source	Population served
Las Vegas	13 wells—650 to 1,250' depth plus Lake Mead supply.	40,000
Game Reserve	400' drilled well	20
Indian Springs	600' drilled well	Average 250
Pahrump	75' driven well	10-50
Ash Meadows	Spring 25' deep	8
Lathrop Wells	3 wells—600' deep	Average 15
Beatty	Spring	550
Lida Junction	125' drilled well	2-10
Goldfield	Spring	Average 200
Tonopah	2 drilled wells—60' depth	Average 1,500
Warm Springs	Multiple springs—no improvement	10
Diablo	Well	State Highway Station
Lincoln Mine	2 driven wells	3
Caliente	Springs	Average 10-12
Crystal Springs	Free flowing spring	0
Alamo	2 wells—50-67' deep	Average 175
Pahranagat Lake	Surface	Not used for domestic purposes
Butler Ranch	Flowing spring	1
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool
Logandale	Drilled well	300
Ballistic Range	Drilled well	10-15

104<

GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE FOR MAY-JUNE 1960

(μc/ml at count time)

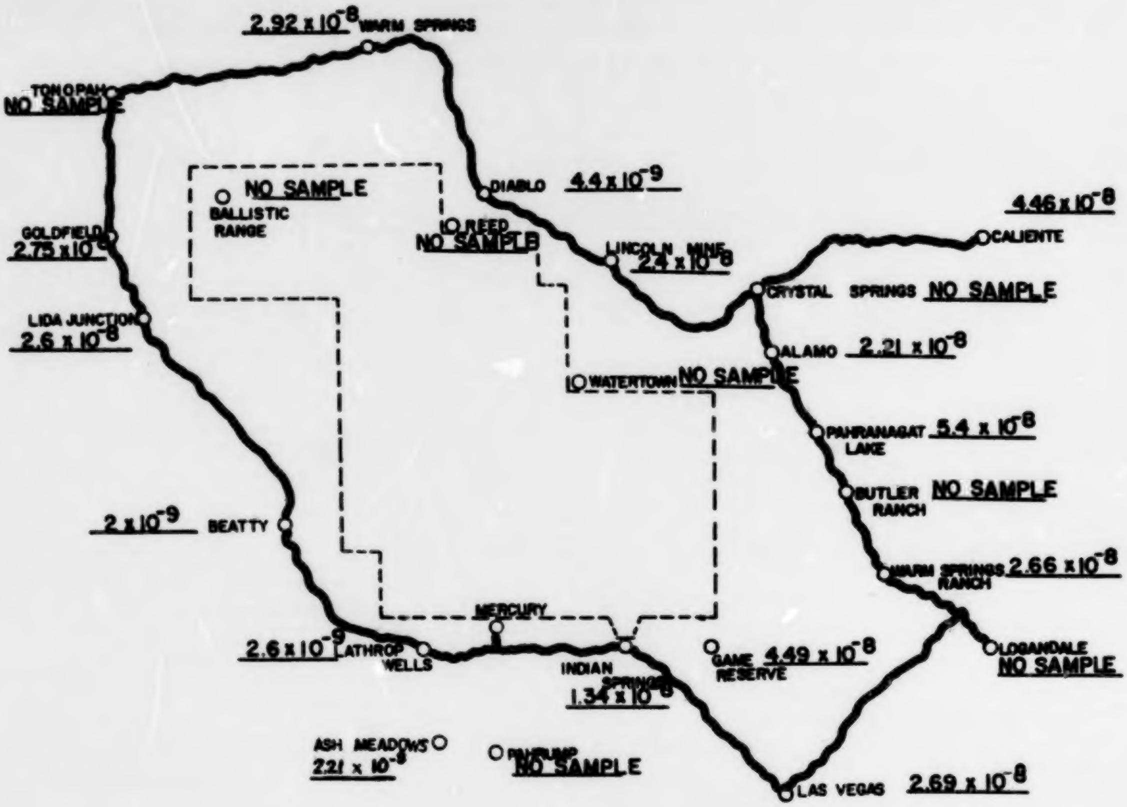
2.92×10^{-8} WARM SPRINGS
TONOPAH
NO SAMPLE
NO SAMPLE
BALLISTIC RANGE
DIABLO 4.4×10^{-9}
4.46×10^{-8}
CALIENTE
GOLDFIELD
2.75×10^{-8}
REED
NO SAMPLE
LINCOLN MINE
2.4×10^{-8}
CRYSTAL SPRINGS NO SAMPLE
LIDA JUNCTION
2.6×10^{-8}
ALAMO 2.21×10^{-8}
WATERTOWN NO SAMPLE
PAHRANAGAT LAKE 5.4×10^{-8}
BUTLER RANCH NO SAMPLE
2×10^{-9} BEATTY
WARM SPRINGS RANCH 2.66×10^{-8}
MERCURY
2.6×10^{-9} LATHROP WELLS
INDIAN SPRINGS
1.34×10^{-8}
GAME RESERVE 4.49×10^{-8}
LOGANDALE
NO SAMPLE
ASH MEADOWS
2.21×10^{-8}
PAHRUMP
NO SAMPLE
LAS VEGAS 2.69×10^{-8}

FIGURE 1

442

SECTION IV.—OTHER DATA

EXTERNAL GAMMA ACTIVITY

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are, within the variance anticipated due to differences in normal background and in instrument response characteristics.

TABLE 1.--EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

June 1960

Station Location	Average*	Station Location	Average*
	mr/hr		mr/hr
Alaska, Anchorage	0.01	Mississippi, Pascagoula	(**)
Alaska, Fairbanks	0.01	Missouri, Jefferson City	0.01
Alaska, Juneau	0.02	Montana, Helena	0.03
Arizona, Phoenix	0.01	New Jersey, Trenton	0.02
Arkansas, Little Rock	0.02	New Mexico, Santa Fe	0.04
California, Berkeley	0.01	New York, Albany	0.02
California, Los Angeles	0.01	North Carolina, Gastonia	0.02
Colorado, Denver	0.02	Ohio, Cincinnati	(**)
Connecticut, Hartford	0.01	Oklahoma, Oklahoma City	0.02
District of Columbia	0.02	Oklahoma, Ponca City	0.04
Florida, Jacksonville	0.01	Oregon, Portland	0.02
Georgia, Atlanta	0.02	Pennsylvania, Harrisburg	0.01
Hawaii, Honolulu	0.02	Rhode Island, Providence	0.02
Idaho, Boise	0.02	South Carolina, Columbia	0.02
Illinois, Springfield	0.01	South Dakota, Edgemont	(**)
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.02	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.01	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.01	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02
Minnesota, Minneapolis	0.01		

*Readings taken three feet above the ground.

**No data received.

SUMMARY OF RESEARCH RESULTS
RELATED TO ENVIRONMENTAL RADIOACTIVITY

106<

U. S. Atomic Energy Commission

The results of research in the Atomic Energy Commission's fallout studies program at their various contract laboratories through mid-1960 are summarized below. Refer to the 1959 AEC "Annual Report to the Congress" for a more complete description of individual programs. This summary was prepared by the Division of Biology and Medicine, AEC.

University of California at Los Angeles

Studies of the uptake of cesium-137 and natural potassium by Ladino clover, made at the University of California at Los Angeles, have shown that the uptake of cesium-137 depends on soil type and that the uptake increases as the soil potassium is reduced by continued use of the soil for growing plants. Stable cesium even at toxic levels, added to the soils caused an increase in uptake of cesium-137 while addition of potassium caused a decrease in its uptake. Other studies involving the uptake of strontium-90 by different crop plants showed that uptake among the different types of plants varied by a factor as high as 10 on the same soil. For cereal crops, the grain showed concentrations of strontium-90 only about one-fifth of that in the foliar portion of the plants. The tops of potatoes contained about 50 times that of the tubers. Temperature and light intensity were also shown to affect strontium-90 uptake from soils in barley and beans. Studies of the uptake of stable and radioactive isotopes of cesium, potassium, strontium and calcium have shown that the addition of the stable isotope of each caused an increase in the uptake of the respective radioactive isotope. The stable isotopes appear to increase the water soluble fraction of the radioactive isotope in soils and clay minerals.

Hanford Laboratories

Studies at the Hanford Laboratories have shown that with as much as one ton of phosphorus per acre no reduction of strontium-90 uptake was noted on plants grown on acidic Cinebar soil, but uptake was depressed two to four-fold in calcareous soils. Although this provides a method of reducing uptake of strontium-90 from calcareous soils the amount of phosphorus required is so great that the meager benefit brought about would not warrant its general use. The effect of phosphorus on calcium uptake appeared to be comparable to that on strontium-90 uptake. Studies of strontium-90 in plants grown on different soils suggest that strontium-90 movement is impaired when plants are grown in alkaline soils. After irrigation, marked increases in Zn^{65} uptake from water containing this nuclide are observed only for grass grown where sod is established. Presumably such a sod acts as an excellent absorbing mechanism for taking the Zn^{65} up into the plant material.

In other studies concerned with the accumulation of cesium-137 by plants grown on nutrient solution, it was observed that the accumulation of Cs^{137} was halved when the potassium in solutions was increased 100-fold, but was enhanced by the addition of non-radioactive cesium. Such increases from soil have usually been ascribed to changes in availability whereas this would not appear to be the case with nutrient solution. The fact that it took a 100-fold increase in potassium to cut the uptake of cesium-137 to one-half of its former value indicates that the plants change the degree with which they discriminate between cesium and potassium, and consequently, that the cesium-137/potassium ratio is of little value in predicting future contamination levels in plants from known levels in soils.

Visible toxic symptoms are produced where ratios of non-radioactive cesium to potassium in the root substrate are one or greater. These symptoms are typical of potassium deficiency, but analysis of plant tissues failed to show any decrease in potassium concentration within the plants. The results suggest a competitive mechanism in the metabolism of these two ions. Such competition does not appear to exist for the absorption and translocation processes since potassium and cesium seem to behave independently. In similar studies an increase of two to three-fold in potassium uptake in plant tissue depresses rubidium-86 concentration by five to ten-fold. Thus cesium and potassium appear to be independently accumulated, whereas a partial interaction of potassium on rubidium uptake occurs. The variability of the observed ratios for rubidium/potassium and cesium/potassium demonstrates that neither rubidium nor cesium are ideal tracers for potassium in plant uptake studies.

There was evidence that the roots and stems, in that order, exhibit a preference for strontium, and there is a preferential translocation of calcium from these tissues. This selective retention of strontium occurred only at low strontium/calcium substrate ratios.

444

Uptake of cesium-137 into bean plants was greater when soil moisture was limited than when soil moisture was ample. Variations in available soil moisture did not influence uptake of calcium-45 or strontium-90.

It appears from studies at Hanford that the mature rat's fecal excretion of intraperitoneally administered radioisotope is essentially the same for strontium and calcium, whereas urinary excretion of either element is influenced by the calcium level in the diet. The retention of both strontium-90 and calcium-45 were dependent on the dietary calcium—calcium-45 to a much greater extent than strontium-90. Discrimination between strontium and calcium is effected primarily in the process of absorption from the gastrointestinal tract. These results combine to give a picture of strontium metabolism which differs in significant details from the behavior of calcium.

Studies using a perfusion technique showed that although there is a measurable influx of strontium through the gills of fish, the outflux rate is approximately 100 times greater. Other tests comfirm that ionic strontium can be pumped out of the gills against a concentration gradient. This suggests the gills are a primary organ of strontium regulation in fish.

An ion exchange separation procedure was developed at the Hanford Laboratories for removing metabolized strontium-90 from sheep milk. The radiochemical yield is greater than 82 percent even in the presence of 100 times as much calcium as strontium. This study showed that metabolized strontium-90 can be removed from milk by ion exchange techniques without the necessity of special pre-treatment due to some possible compound formation with the other components of the milk.

Los Alamos Scientific Laboratory

A study of changes in the availability of strontium-90 to plants as a function of the environment in which various nuclear tests have occurred was completed in recent months by the Los Alamos Scientific Laboratory. Nuclear debris was examined in which the principal component was, variously, sodium chloride from explosions, ferric oxide from iron tower explosions and air bursts aluminum oxide from aluminum tower explosions and siliceous material from tests conducted in the presence of large amounts of silica. It was desired to ascertain whether any of these materials lowered the availability of their contained fission products to living plants. The largest effect observed was a decrease of approximately a factor of two in strontium-90 availability from nuclear devices exploded on iron towers or exploded in air at altitudes high enough to avoid inclusion of ground debris. Of the material examined, those from which strontium is least available are iron oxide and aluminum oxide. A nuclear explosion conducted in such a way as to maximize the incorporation of strontium-90 into one or another of these materials might be expected to decrease the availability of this nuclide by some unpredictable factor over what has been observed in any of the debris studies to date

University of Tennessee

Studies in the removal of radioactivity from certain foods have continued at the University of Tennessee Agricultural Research Laboratory. It has been found that cooking beef loin roasts with bones causes movement of strontium from the bone into the meat and drippings. Cesium-134, used as an artificial contaminant, has been removed from milk by an ion exchange resin. Using a batch technique 75 percent of the cesium-134 was removed. Using a column of resin about 99 percent was removed from the first 150 milliliters of milk passed through the column and 95 percent was removed from the twentieth 10 milliliter portion. About 90 percent of iodine-131 has been removed from milk by batch technique with a resin.

To study the effect on nutritive value of ion exchange-treated milk homogenized, vitamin D fortified milk was treated with Dowex 50-W in the calcium form by the batch technique using a milk resin ratio of 20 to 1. Both the treated milk and the control were fortified with copper and iron and fed to weanling rats as the sole source of nutrients. Failure to achieve normal weight gain was noted for the males but not for the females. No impairment of male or female fertility was noted at the end of eight weeks.

108<

ENVIRONMENTAL LEVELS OF RADIOACTIVITY AT ATOMIC ENERGY COMMISSION INSTALLATIONS

The United States Atomic Energy Commission has recently initiated the reporting of radioactivity data collected in the vicinity of major Commission installations. The data are from routine monitoring programs around Commission plants and laboratories where operations are of such a nature that plant perimeter surveys are required.

The yearly summaries of data for the year 1959 and the initial quarterly reports for the first three months of 1960 have been provided the Public Health Service. Summarized below are the yearly and first quarterly reports for seven of the installations. The reports for the remaining installations will be included in the December 1960 issue.

AIRCRAFT NUCLEAR PROPULSION DEPARTMENT

General Electric Company
Cincinnati, Ohio

June 27, 1960

The information presented in this report relates to the various programs conducted by the General Electric Company's Aircraft Nuclear Propulsion (ANP) Department, Cincinnati, Ohio, in the monitoring of the levels of radioactivity in the air and water in and around the area occupied by the ANP Department's plant. The prime purpose of these intensive monitoring programs is to assure the highest standards of health protection for employees and the general population of the surrounding areas.

Airborne Activity

The off-site or community monitoring program for alpha and beta-gamma airborne activity is accomplished by the use of a mobile sampling unit consisting of a 1 1/2 ton panel truck in which are installed a power generator, sampling equipment and meteorological instrumentation. Sampling is generally confined to the communities and General Electric sites within a one mile radius of the ANP Department.

The monitoring interval is one hour at each location with approximately three sets of downwind samples taken per day. Also on each sampling day a set of upwind background measurements are completed for comparison purposes. During the sampling period, M.S.A. electrostatic precipitators are used for the collection of alpha activity from air samples, while beta-gamma activity is collected by filtering the air through Whatman No. 41 filter paper. Proportional counters are used for analyzing the collected air samples. The beta-gamma samples are held for five days before being counted. The average concentrations of long-lived alpha and beta-gamma activity in air are summarized in Table 1.

TABLE 1.--AIRBORNE ACTIVITY

	1959		First quarter 1960	
	No. samples	Average concentration $\mu\mu c/m^3$	No. samples	Average concentration $\mu\mu c/m^3$
Long Lived Alpha				
Upwind	479	0.042	86	0.034
Downwind	734	0.041	153	0.038
Beta-Gamma Activity				
Upwind	325	5.9	67	0.37
Downwind	515	5.4	109	0.37

446

Liquid Waste Activity

The ANP Department is equipped with a special drain system and retention tanks whereby liquid wastes from the laboratory areas are collected, held and monitored before their disposal to the Cincinnati Metropolitan Sewerage System. The purpose of this liquid effluent system is to provide a positive method for assuring that the liquid waste effluent from the ANP Department is well within the limits for safe disposal as specified by the City of Cincinnati and the National Committee on Radiation Protection. Table 2 summarizes the results of the samples collected from the liquid effluent holding tanks.

TABLE 2.–LIQUID WASTE FROM DRAIN SYSTEM

	1959	First quarter 1960
Total Volume	4,005,000 gallons	979,000 gallons
Monthly Average Volume	333,750 gallons	326,333 gallons
Average Concentration	4,100 $\mu\mu$c U/liter	3,100 $\mu\mu$c U/liter
Control Limit *	72,700 $\mu\mu$c U/ liter	153,200 $\mu\mu$c U/liter

*Control limit in use at these particular times. Limit applied in 1960 was raised due to increase in volumes of dilution water in 1959.

General Conclusions

The data obtained in the environmental airborne and liquid effluent radioactivity monitoring programs during 1959 and the first quarter of 1960 indicate that the operations at ANP Department contributed an insignificant amount of radioactivity to the air and liquid wastes discharged to the City of Cincinnati Sewerage System.

BETTIS ATOMIC POWER LABORATORY

Westinghouse Electric Corporation
Pittsburgh, Pennsylvania

June 1, 1960

The Bettis Atomic Power Laboratory (BAPL) at Pittsburgh, Pennsylvania, operated for the United States Atomic Energy Commission (AEC) by the Westinghouse Electric Corporation, was established in 1949 and since that time has been engaged in research and development work related to naval atomic propulsion systems and the central station atomic power reactor at Shippingport.

Liquid Waste Activity

The liquid effluent discharged from the Laboratory is sampled continuously and a composite sample is collected and analyzed weekly. This measured concentration may include fallout from rainfall and runoff that has entered the effluent line through the Laboratory storm drainage system. The measured concentrations of total radioactivity and strontium-90 in the liquid effluent discharged during 1959 and first quarter of 1960 are summarized in Table 1.

110<

TABLE 1.–RADIOACTIVITY IN LIQUID EFFLUENT

Periods	Gross radioactivity μμc/liter	Strontium-90 μμc/liter
First Quarter 1959	270	4.5
Second Quarter 1959	140	2.4
Third Quarter 1959	120	(*)
Fourth Quarter 1959	190	(*)
First Quarter 1960	230	(*)
January 1960	330	(*)
February 1960	150	(*)
March 1960	130	(*)

*Results will be reported in BAPL's second quarter report, to be published in a subsequent issue.

External Beta-Gamma Activity

External beta-gamma radiation levels are continuously monitored and recorded at a monitoring station located on the western boundary of the Laboratory property. The results of the data taken during 1959 and the First quarter of 1960 are listed in the following table.

TABLE 2.–EXTERNAL BETA-GAMMA ACTIVITY

Periods	Average beta-gamma radiation levels (millirads/hr)
First Quarter 1959	0.013
Second Quarter 1959	.014
Third Quarter 1959	.015
Fourth Quarter 1959	.015
First Quarter 1960	.016

The values are within the 0.008 to 0.038 mr/hr range of background gamma radiation levels measured in 1957 by the Atomic Energy Commission throughout the United States.

Fallout Activity

Fallout samples are collected at six stations near the boundary of the Laboratory property. Samples are collected in open trays that are lined with a special gummed paper. These stations measure not only day-to-day fallout from the atmosphere, but also can pick up fallout that may be present in dust created by the movement of vehicles and construction work in the immediate vicinity. The average concentrations of radioactivity in the fallout samples collected weekly during 1959 and the first quarter of 1960 are presented in the following table.

TABLE 3.–BETA RADIOACTIVITY IN FALLOUT

(mc/mi^2/month)

Periods	Average beta radioactivity	
	Upwind	Downwind
First Quarter 1959	155	162
Second Quarter 1959	136	136
Third Quarter 1959	9	10
Fourth Quarter 1959	5	8
First Quarter 1960	5	5
January 1960	4	4
February 1960	7	8
March 1960	4	4

Soil Activity

Soil samples from the perimeter of the Laboratory have been collected periodically since 1949. The following table compares concentrations of radioactivity contained in soil samples collected in 1949 and 1959.

TABLE 4.–ALPHA AND BETA RADIOACTIVITY IN SOIL

(Average concentrations)

Year samples collected	Alpha, $\mu\mu$c/gram	Beta, $\mu\mu$c/gram
1949	18	16
1959	18	27

These data indicate some general increase in concentrations of beta radioactivity in the soil from 1949 to 1959. This increase is believed to be due to fallout from past weapons testing. Similar increases have been observed in soil samples collected in other parts of the country.

Conclusions

The measurements of radioactivity in the fallout and the soil, as well as measurements of background radiation intensities at the boundaries of the Bettis Atomic Power Laboratory throughout 1959 and the first quarter of 1960, show no significant effects on the environmental radioactivity levels caused by Laboratory operations.

112<

CONNECTICUT AIRCRAFT NUCLEAR ENGINE LABORATORY

Pratt & Whitney Aircraft
Division of United Aircraft Corporation
Middletown, Connecticut

April-May 1960

The environment on and around the Connecticut Aircraft Nuclear Engine Laboratory (CANEL) site has been sampled throughout 1959 and the first quarter of 1960. The environmental monitoring program consisted of collection and analysis of water, soil, silt, drinking water, Connecticut River water and silt, process water, domestic sewer water, precipitation, fallout, and air samples. Vegetation samples were collected but have not been analyzed.

The CANEL facility has two retention tank vaults which are designed to collect laboratory liquid wastes which have the potential of being radioactive. These tanks are sampled and analyzed before they are permitted to be released to the Connecticut River. All samples are analyzed for gross alpha and gross beta activity.

The data from these samples (air, water, soil, silt, precipitation, and fallout) have been analyzed and compared with similar data taken in 1958. There have been no cases of statistically significant increases in activity.

The data from the environmental water, soil and silt samples were statistically analyzed by using three variables of classification; i.e., date, distance and direction from the center of the CANEL site. Statistically significant effects appeared for these variables and/or their combinations which initiated a review of the operations and the meteorological conditions. No unusual incidents occurred at CANEL which could reasonably be expected to have caused these variations. Selected stacks, which have the highest probability of emitting radioactive materials, were continuously monitored. There is no evidence to justify concern about the amount of material which may have been released from these stacks. Therefore, it has been concluded that these statistically significant effects have been caused by natural variations and are not due to CANEL operations.

The following tables summarize the data from the environmental monitoring program.

TABLE 1.—ENVIRONMENTAL WATER

Activity	1959		First quarter 1960	
	No. samples	Average μμc/liter	No. samples	Average μμc/liter
Soluble Alpha	320	0.20	60	0.16
Soluble Beta	320	11.7	60	4.0
Insoluble Alpha	320	0.24	60	0.01
Insoluble Beta	320	12.3	60	2.8

TABLE 2.--SOIL

Activity	1959		First quarter 1960	
	No. samples	Average μμc/gram	No. samples	Average μμc/gram
Alpha	448	2.11	84	2.63
Beta	448	37.8	84	23.8

450

TABLE 3.–DRINKING WATER

Two Wells

Activity	1959		First quarter 1960	
	No. samples	Average μμc/liter	No. samples	Average μμc/liter
Soluble Alpha	18	0.21	5	0.72
Soluble Beta	18	7.0	5	4.13
Insoluble Alpha	18	0.15	5	0.07
Insoluble Beta	18	3.27	5	5.47

TABLE 4.–CONNECTICUT RIVER WATER

Location	Activity	1959		First quarter 1960	
		No. samples	Average μμc/liter	No. samples	Average μμc/liter
North Boundary of Site	Sol. α	15	0.25	3	0.14
	Sol. β	15	11.4	3	1.8
	Insol. α	15	0.21	3	0.21
	Insol. β	15	5.9	3	3.0
South Boundary of Site	Sol. α	15	0.23	3	0.08
	Sol. β	15	10.4	3	3.47
	Insol. α	14	0.24	3	0.08
	Insol. β	14	9.5	3	6.36

TABLE 5.–PRECIPITATION

Activity	1959		First quarter 1960	
	No. samples	Average μμc/liter	No. samples	Average μμc/liter
Soluble Alpha	61	0.22	18	0.62
Soluble Beta	61	144	18	28.3
Insoluble Alpha	61	0.18	18	0.10
Insoluble Beta	61	39.9	18	5.64

TABLE 6.–FALLOUT

Activity	1959		First quarter 1960	
	No. samples	Average $d/m/ft^2$	No. samples	Average $d/m/ft^2$
Alpha	247	2.94	50	2.76
Beta	247	377	50	258

TABLE 7.--AIR SAMPLES

Location	Activity	1959		First quarter 1960	
		No. samples	Average μμc/m³	No. samples	Average μμc/m³
Weather station	Alpha	181	0.002	41	0.00265
	Beta	180	1.79	41	.16
On and Around Site	Alpha	24	.006	-	-
	Beta	24	1.58	-	-

TABLE 8.--SUMMARY

	1959		First quarter 1960	
	Average total gross activity μμc/liter	Percent MPC *	Average total gross activity μμc/liter	Percent MPC *
Environmental water	24.4	24.4	7.0	7.0
Drinking water	10.6	10.6	10.4	10.4
Connecticut River water	19.1	19.1	7.6	7.6
Precipitation	184.4	184.4	34.7	34.7

*MPC is 100 μμc/liter for 168-hour per week exposure for isotopes other than Ra^{226} and Ra^{228}, as stated in National Bureau of Standards Handbook 69, Table No. 3, issued June 5, 1959.

MOUND LABORATORY

Monsanto Chemical Company
Miamisburg, Ohio

July 5, 1960

The Mound Laboratory is operated by the Monsanto Chemical Company under contract to the Atomic Energy Commission.

Monsanto Chemical Company has conducted a routine environmental air monitoring program in the Southeastern section of Ohio since operations began at Mound Laboratory in 1949. Sixty-seven locations are routinely monitored in all directions from the Laboratory out to a distance of approximately 40 miles.

The radioactive nuclides presently in use at the Laboratory are polonium-210 and plutonium-239 which are alpha emitters. During the periods covered by the following air monitoring results, no radioactive materials have been used which could have contributed any measurable gamma or beta radiation to the environment. Therefore, measurements have naturally been confined to alpha.

Tables 1 to 3 show gross alpha in air and water for the area around Miamisburg, Ohio for 1959 and the first quarter of 1960. Readings for 1959 contain polonium-210 plus natural background, while the first quarter of 1960 includes the possibility of plutonium-239.

TABLE 1.–GROSS ALPHA IN AIR DURING 1959
(Polonium plus natural background)

Distance from Mound Laboratory	Number of sampling locations	Average concentration $\mu\mu c/m^3$
0-5 miles	12	0.123
5-15 miles	15	.118
15-30 miles	26	.094
30-40 miles	14	.116

TABLE 2.–GROSS ALPHA ACTIVITY IN AIR FROM POLONIUM AND PLUTONIUM
First quarter 1960
(Not including natural background)

Distance from Mound Laboratory	Number samples	Number of sampling locations	Average concentration $\mu\mu c/m^3$
0-5 miles	70	12	0.036
5-15 miles	13	15	.027
15-30 miles	23	26	0
30-40 miles	13	14	.027

TABLE 3.–GROSS POLONIUM RADIOACTIVITY IN THE GREAT MIAMI RIVER

Sample location	Average concentration in $\mu\mu c$/liter	
	Calendar year 1959	First quarter 1960
Mound lab. effluent	136	326
200 yards downstream	8.8	0.7
250 " "	4.9	0.9
300 " "	4.1	4.5
1 mile "	2.0	0.2
2 miles "	4.4	.9
5 miles "	1.4	1.6
over 5 miles "	0.0	0.0

PORTSMOUTH GASEOUS DIFFUSION PLANT

116<

Goodyear Atomic Corporation
Portsmouth, Ohio

Issued July 1960

The U. S. Atomic Energy Commission facility in Pike County, Ohio, operated by the Goodyear Atomic Corporation, is a gaseous diffusion plant. Gaseous diffusion is the process by which isotopes of uranium are separated for useful purposes. Uranium as found in nature consists of three isotopes, uranium-238, uranium-235, and uranium-234. It is a naturally occurring slightly radioactive element.

The chemical processing of gaseous uranium presents the ordinary problems of the chemical industry which use toxic solvents and extracting solutions. Fumes and mists must be controlled and contaminants removed by filtering, scrubbing, or other practical means to prevent atmospheric contamination.

An extensive environmental survey is conducted on a monthly basis for radioactive materials that may be released from the plant to check the effectiveness of controls which are used. The program is also designed to determine the effect, if any, on the surrounding environment. The routine program consists of sampling water, mud, air, and the general radiation background levels. The samples are collected up to five miles from the plant at various distances and directions with the majority being in the prevailing wind direction. The following tables report the concentrations of alpha and beta-gamma activity in air and stream water for 1959 and the first quarter of 1960.

454

TABLE 1.--GROSS STREAM WATER ACTIVITY

(Average concentrations in $\mu\mu$c/liter)

Stream & location from plant	Calendar year 1959					First quarter 1960				
	No. samples	Alpha	Percent MPC*	Beta & Gamma	Percent MPC*	No. samples	Alpha	Percent MPC*	Beta & Gamma	Percent MPC*
Scioto River 4-5 mi SSW	11	4.9	0.025	18.9	0.095	3	2.7	0.014	18	0.090
Salt Creek 2-3 mi SSW	11	4.1	.021	18.4	.092	3	4	.020	18	.090
Salt Creek 1 mi S	11	14.4	.072	31.5	.158	3	5.8	.029	18	.090
Big Beaver 3-4 mi ENE	11	5.8	.029	14.8	.074	3	2.3	.012	18	.090
Big Beaver 2-3 mi NNW	11	8.1	.041	16.6	.083	3	4	.020	13.5	.068
Scioto River 4-5 mi N	11	4.9	.025	31.9	.160	3	3	.015	13.5	.068
Little Beaver 2 mi NW	11	69.3	.347	134.7	.674	3	32.4	.162	72	.360
Little Beaver 1-2 mi NNW	11	109.0	.595	354.0	1.770	3	16	.080	40.5	.203
Plant drainage 0 mi SW	10	4.9	.025	36.4	.182	3	3.6	.018	18	.090
Plant drainage 0 mi W	11	7.6	.038	33.3	.167	3	6	.030	22.5	.113
Plant drainage 0 mi NE	11	423.4	2.117	854.4	4.297	3	126	.630	85.6	.428
Little Beaver 1 mi E	11	35.6	.178	22.5	.113	3	1.4	.007	18	.090
Big Beaver 2 mi NW	11	31.5	.158	54.5	.273	3	1.4	.007	13.5	.068
Scioto River 1-2 mi W	11	9.0	.045	24.3	.122	3	2.7	.014	13.5	.068

*The values for the maximum permissible concentrations (MPC) for air and water are one-tenth of the MPC allowed for continuous occupational exposure as given in Handbook 69, U. S. Department of Commerce, National Bureau of Standards, issued June 5, 1959.

TABLE 2.–GROSS AIR ACTIVITY

(Average concentrations in $\mu\mu c/m^3$)

Location from plant	Calendar year 1959					First quarter 1960				
	No. samples	Alpha	Percent MPC*	Beta & Gamma	Percent MPC*	No. samples	Alpha	Percent MPC*	Beta & Gamma	Percent MPC*
5-6 mi W	12	0.08	4.0	5.0	0.5	3	0.008	0.4	0.4	0.04
2-3 mi W	12	.08	4.0	3.3	.33	3	0	0	.009	.01
4 mi NW	12	.08	4.0	4.6	.46	3	.008	0.4	.08	.01
3-4 mi SW	12	.1	5.0	2.7	.27	3	.01	0.5	.13	.01
4-5 mi N	12	.05	2.5	3.1	.31	3	.02	1.0	.02	0
2-3 mi NNW	12	.08	4.0	3.8	.38	3	.02	1.0	.008	0
2-3 mi N	12	.03	1.5	5.2	.52	3	0	0	.09	.01
1-2 mi S	12	.08	4.0	3.3	.33	3	.02	1.0	.27	.03
3-4 mi SSE	12	.09	4.5	2.6	.26	3	.02	1.0	.08	.01
1 mi E	12	.5	25.0	2.9	.29	3	.02	1.0	.21	.02
5 mi E	12	.05	2.5	3.5	.35	3	.008	.4	.1	.01
5-6 mi NE	12	.1	5.0	2.3	.23	3	.04	2.0	.4	.04
5-6 mi NE	12	.1	5.0	2.5	.25	3	.09	4.5	.4	.04
4 mi NE	12	.08	4.0	2.3	.23	3	.08	4.0	.27	.03
2-3 mi SSW	12	.05	2.5	2.4	.24	3	.05	2.5	.4	.04

*The values for the maximum permissible concentrations (MPC) for air and water are one-tenth of the MPC allowed for continuous occupational exposure as given in Handbook 69, U. S. Department of Commerce, National Bureau of Standards, issued June 5, 1959.

TABLE 3.–GROSS BETA-GAMMA BACKGROUND RADIATION LEVELS

(Millirads/hour)

Location from plant	Calendar year 1959		First quarter 1960	
	No. samples	Average rate	No. samples	Average rate
5-6 mi W	12	0.031	3	0.022
2-3 mi W	12	0.024	3	0.016
4 mi NW	12	0.021	3	0.011
3-4 mi SW	12	0.025	3	0.019
4-5 mi N	12	0.033	3	0.013
2-3 mi NNW	12	0.019	3	0.010
2-3 mi N	12	0.034	3	0.013
1-2 mi S	12	0.030	3	0.015
3-4 mi SSE	12	0.021	3	0.017
1 mi E	12	0.029	3	0.018
5 mi E	12	0.044	3	0.022
5-6 mi NE	12	0.029	3	0.016
5-6 mi NE	12	0.028	3	0.015
4 mi NE	12	0.024	3	0.014
2-3 mi SSW	12	0.032	3	0.016

119<

SIC PROTOTYPE REACTOR FACILITY

Combustion Engineering, Inc.
Windsor, Connecticut

July 1960

The SIC Prototype is a land-based nuclear submarine power plant facility. This facility is operated for the United States Atomic Energy Commission by the Naval Reactors Division of Combustion Engineering, Inc., at Windsor, Connecticut. The SIC Prototype contains a pressurized water reactor. It is used to conduct research and development work as well as to train personnel in operation of naval reactor power plants. Power reactor operations at the Windsor facility were initiated in December of 1959.

Essentially all of the radioactive wastes originate from the activation of minute amounts of impurities and corrosion products in the circulating water used as the reactor coolant. Small quantities of gaseous waste result from the activation of minute amounts of air dissolved in the coolant water.

The disposal methods and limits in use at the Prototype were reviewed by the Connecticut State Department of Health and their approval was obtained before operations began. Complete waste disposal records are maintained at this facility and these records are examined every four months by representatives from the State Department of Health.

Liquid Wastes

Liquid wastes are collected in 5000 gallon retention tanks. When a tank is full it is sampled and analyzed for radioactivity content. If the activity is below allowable discharge limits, the tank is released into the industrial waste system. If the activity is above the allowable discharge limit it is diluted to below acceptable limits and then released. Table 1 is a summary of gross radioactivity released to the Farmington River.

TABLE 1.—SUMMARY OF GROSS RADIOACTIVITY RELEASED TO THE FARMINGTON RIVER

Month	Total for month microcuries	Average per day microcuries	Averaged concentration released ($\mu\mu c$/liter)
January	24.5	0.79	59
February	15.3	0.53	57
March	19.2	0.62	77
	59.0		

The Farmington River is sampled monthly at various locations for determination of alpha and beta-gamma activity in river water and mud. The results of this sampling are presented in Table 2.

457

TABLE 2.–SUMMARY OF FARMINGTON RIVER MONITORING PROGRAM

First quarter 1960

Location	Water samples				Mud samples			
	No. samples	Alpha μμc/l	Beta-Gamma μμc/l	ppm uranium	No. samples	Alpha μμc/l	Beta-Gamma μμc/l	ppm uranium
UPSTREAM								
Spoonville Bridge	2	47	< 4.5	0.002	2	2.18	1.62	0.62
Above Brook	1	23	23	ND*	1	4.46	5.28	1.33
OUTLET								
Mouth of Brook	1	50	4.5	ND*	1	3.87	3.32	0.48
DOWNSTREAM								
Below Brook	1	36	< 4.5	0.001	-	-	-	-
Rainbow Dam	2	34	< 4.5	0.003	1	1.23	5.56	0.76
Windsor Bridge	2	< 23	4.5	ND*	1	2.55	< 1.6	1.3

*ND–non-detectable.

Table 3 presents a comparison of operational and pre-operational radioactivity levels of water samples from the Farmington River.

TABLE 3.–COMPARISON OF RESULTS OF FARMINGTON RIVER MONITORING PROGRAM

(μμc/liter)

Location	Pre-operational averages		First quarter averages	
	Alpha	Beta-gamma	Alpha	Beta-gamma
Upstream	35	17	55	5.2
Outlet	50	4.5	54	4.5
Downstream	23	< 4.5	30	5.6

Fallout

Radioactive fallout is collected on a weekly basis at six locations around the site and analyzed for gross radioactivity. Off-site fallout collections in neighboring towns are also made and analyzed for gross radioactivity. Table 4 presents this data.

TABLE 4.–SUMMARY OF BETA RADIOACTIVITY IN FALLOUT

First Quarter 1960

(mc/mi^2/month)

		Prototype site					Off-site in neighboring towns						
Station	1	2	3	4	5	6	22	23	24	26	28	29	30
No. of samples	12	11	11	2	12	11	10	9	8	9	11	11	5
Monthly average	3.87	3.05	2.12	1.00	2.47	3.43	2.75	1.76	1.90	1.83	2.82	2.09	2.45

Monthly average of all Prototype site sampling stations–2.66 mc/mi^2/month

Monthly average of all off-site sampling stations–2.23 mc/mi^2/month

Airborne Waste Effluent

Ventilation air from the submarine hull is continuously monitored at the exhaust stack. Airborne waste effluent radioactivity is summarized in Table 5.

TABLE 5.—SUMMARY OF AIRBORNE WASTE EFFLUENT BETA RADIOACTIVITY

(Taken at point of release)

Month	Average value $\mu\mu c/m^3$
January	55
February	40
March	75

Conclusion

Measurements of the radioactivity in the Farmington River, the industrial waste effluent from the plant, air and fallout in the vicinity of the SIC Prototype during the first quarter of 1960 showed no significant contribution of radioactivity from the Prototype to the environment.

WELDON SPRING PLANT

Mallinckrodt Chemical Works Uranium Division
Weldon Spring, Missouri

Issued July 1960

Off-site environmental monitoring programs are conducted at the Weldon Spring Plant of the Mallinckrodt Chemical Works (MCW) Uranium Division to provide a check on those programs established to minimize the release of uranium-bearing materials. This report presents the data obtained during 1959 and the first quarter of 1960.

Since the primary feed material for the MCW Uranium Division operations is natural uranium ore concentrates, off-site environmental releases from the operations are measured in the terms of uranium content, and expressed as special uranium microcuries in accordance with the National Bureau of Standards Handbook No. 69, page 14, Section 3.2, which defines a curie of recently extracted uranium as the sum of 3.7×10^{10} d/s from U^{238}, 3.7×10^{10} d/s from U^{234} and 9×10^{8} d/s from U^{235}. Hence at MCW, the special uranium curie value of an uranium-bearing sample found to contain an alpha activity of 3.7×10^{10} d/s is 0.5 curies.

An evaluation of the collected off-site environmental sampling program data indicates that the uranium concentration found in the Missouri River, off-site air, and adjacent lakes, streams, etc. did not differ significantly from the uranium concentration levels measured prior to the start-up of operations at the MCW Uranium facilities.

The following tables summarize the data from the off-site monitoring program.

TABLE 1.–URANIUM CONCENTRATIONS IN ENVIRONMENTAL WATER

(Average concentrations in $\mu\mu$c/liter)

Location	Calendar year 1959			First quarter 1960		
	No. samples	Concen-tration	Percent MPC *	No. samples	Concen-tration	Percent MPC *
Process sewer	261	300	1.5	45	970	4.8
Missouri River						
St. Louis Water Plant Intake	12	70	0.35	3	34	.17
St. Louis County Water Plant Intake	12	40	.20	3	33	.16
Nearby Lakes	36	20	.10	9	41	.20
Run-off Drainage Canals and Creeks	96	50	.25	24	71	.36

* The value for the maximum permissible concentration (MPC) for water is one-tenth of the MPC allowed for continuous occupational exposure as given in Handbook 69, U. S. Department of Commerce, National Bureau of Standards, issued June 5, 1959.

TABLE 2.--URANIUM CONCENTRATIONS IN ENVIRONMENTAL AIR

(Average concentrations in $\mu\mu$c/m^3)

Location	Calendar year 1959			First quarter 1960		
	No. samples	Concen-tration	Percent MPC *	No. samples	Concen-tration	Percent MPC *
N of plant	14	0.23	12	3	0.33	16
NE of plant	13	.20	10	3	.24	12
E of plant	14	.17	8	3	.42	21
SE of plant	13	.20	10	-	-	-
S of plant	14	.04	2	3	1.04	52
SW of plant	13	.07	3	2	.41	20
W of plant	14	.04	2	-	-	-
NW of plant	13	.05	2	2	.24	12

* The value for the maximum permissible concentration (MPC) for air is one-tenth of the MPC allowed for continuous occupational exposure as given in Handbook 69, U. S. Department of Commerce, National Bureau of Standards, issued June 5, 1959.

STRONTIUM-90 IN WHEAT AND WHEAT PRODUCTS

Health and Safety Laboratory
United States Atomic Energy Commission

The first non-milk analyses related to diet carried out by the Atomic Energy Commission Health and Safety Laboratory were a series of wheat samples from Minnesota. This sampling was then extended to cover the major wheat producing areas in the United States. The first sampling was of the 1958 crop and additional samplings have been made for 1959 and will be made for 1960.

There has been some question as to whether the Sr^{90} in wheat was incorporated into the grain or whether it was merely present as a surface contaminant. A number of the samples collected for 1958 were taken during processing so that the flour, bran and other milling products could be sampled along with the original wheat. The results of wheat and milling product analyses are shown graphically in Figure 1.[1] There are indications that the bran is highest in Sr^{90} and that at least a portion of the Sr^{90} is a surface deposit. The interpretation of these data is still open to some question since it is possible for a portion of the surface contamination to be transferred to the flour fraction. This will be discussed further, later in this report.

Material balances for calcium and for Sr^{90} were presented in Table X, page 33, Radiological Health Data, October 1960.[2] The values used in this table are averages of all 1958 data. The relative weight distribution of the milled fractions was obtained from a mill in Mandan, North Dakota and is assumed to be typical for the United States. Such a material balance is a good indicator of the validity of analytical data on milling products. The patent flour concentration is one-fifth of that in the original wheat.

Wheat analyses for the 1959 crop from several states are shown in Figure 2.[2] Additional material for 1959 is in process, and these data are needed before any comparison of 1958 with 1959 can be made.

To test the degree of removable surface contamination, a sample of Colorado wheat was water leached for two hours. From 6-8% of the Sr^{90} and 3-5% of the calcium was removed. This is an insignificant decontamination.

In Table 1 are shown the results of an experiment, conducted at the Health and Safety Laboratory, designed to estimate what fraction of the Sr^{90} found in wheat can be removed by stripping it[3] of the outermost layers of bran layer (beeswing). It is apparent that about 25% of the total Sr^{90} content of the wheat resides in the strippable beeswing fraction of the bran. The stripped beeswing is only about 4% of the weight of the wheat, while the bran is 11%. With a mean of 40% of the Sr^{90} in the bran, the beeswing is apparently more contaminated. The origin of this Sr^{90}, whether from foliar deposition or root uptake, is currently under investigation.

The relatively high levels of Sr^{90} in the bran portion of the wheat led to a series of analyses on bran products used as breakfast foods. Two such studies have been made. Data for the one by the Public Health Service were presented in Radiological Health Data, July 1960, page 97. The study by HASL is continuing and additional data will be published as soon as it becomes available.

The Public Health Service data show lower values than would be expected from 1958 and 1959 wheat analyses. Again, the representativeness of sampling should be considered in extrapolating to a national diet.

TABLE 1.--TEST OF SR^{90} REMOVAL BY STRIPPING OF WHEAT

Portion	Weight (kg)	$\frac{\mu\mu c\ Sr^{90}}{kg}$	$\frac{gm\ Ca}{kg}$	Total	
				$\mu\mu c\ Sr^{90}$	gm of Ca
Hard red winter wheat	1.000	47.2	0.49	47.2	0.49
Stripped wheat	0.958	37.8	0.44	36.2	0.42
Beeswing stripped from wheat	0.042	302	1.65	12.7	0.07

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[1] Reported in HASL-77 and HASL-84 and AEC Quarterly Statement on Fallout, April 28, 1960.

[2] Reported in HASL-84 and AEC Quarterly Statement on Fallout, April 28, 1960.

[3] The wheat was stripped for HASL by Mr. Theodore Earle using his patented process.

Figure 1 STRONTIUM^{90} IN 1958 WHEAT AND MILLING PRODUCTS

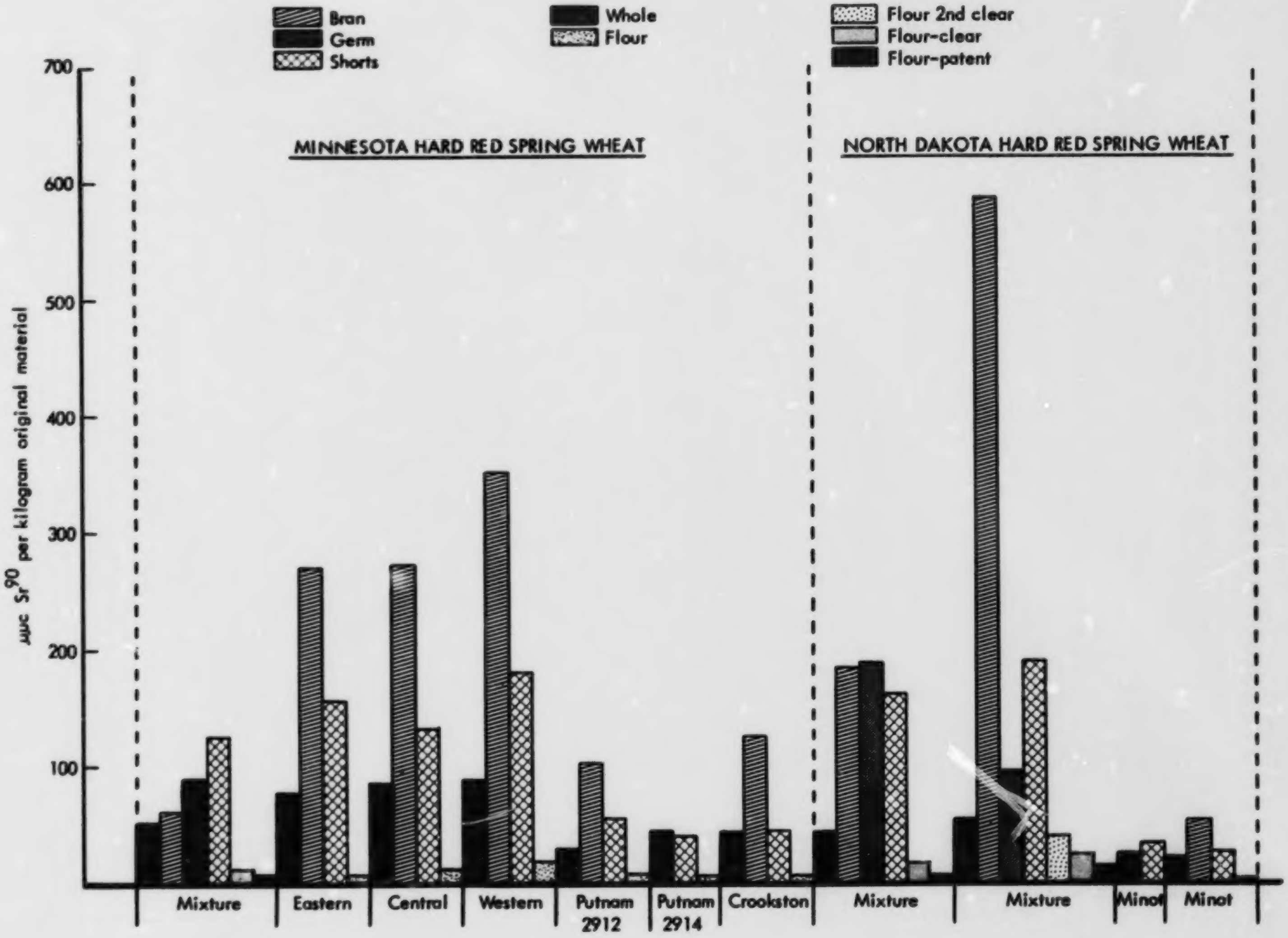


Figure 1. (cont.) STRONTIUM^{90} IN 1958 WHEAT AND MILLING PRODUCTS

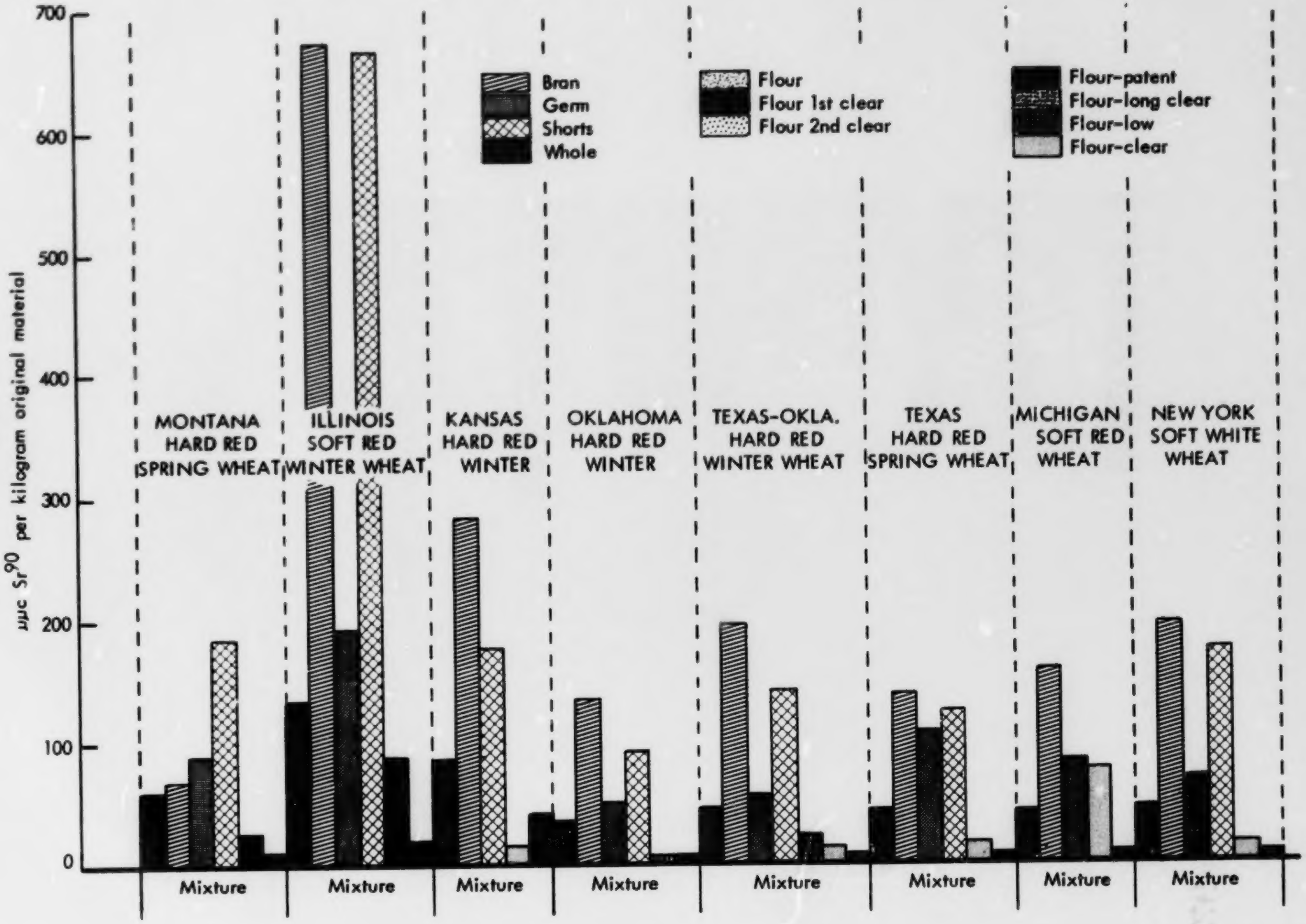
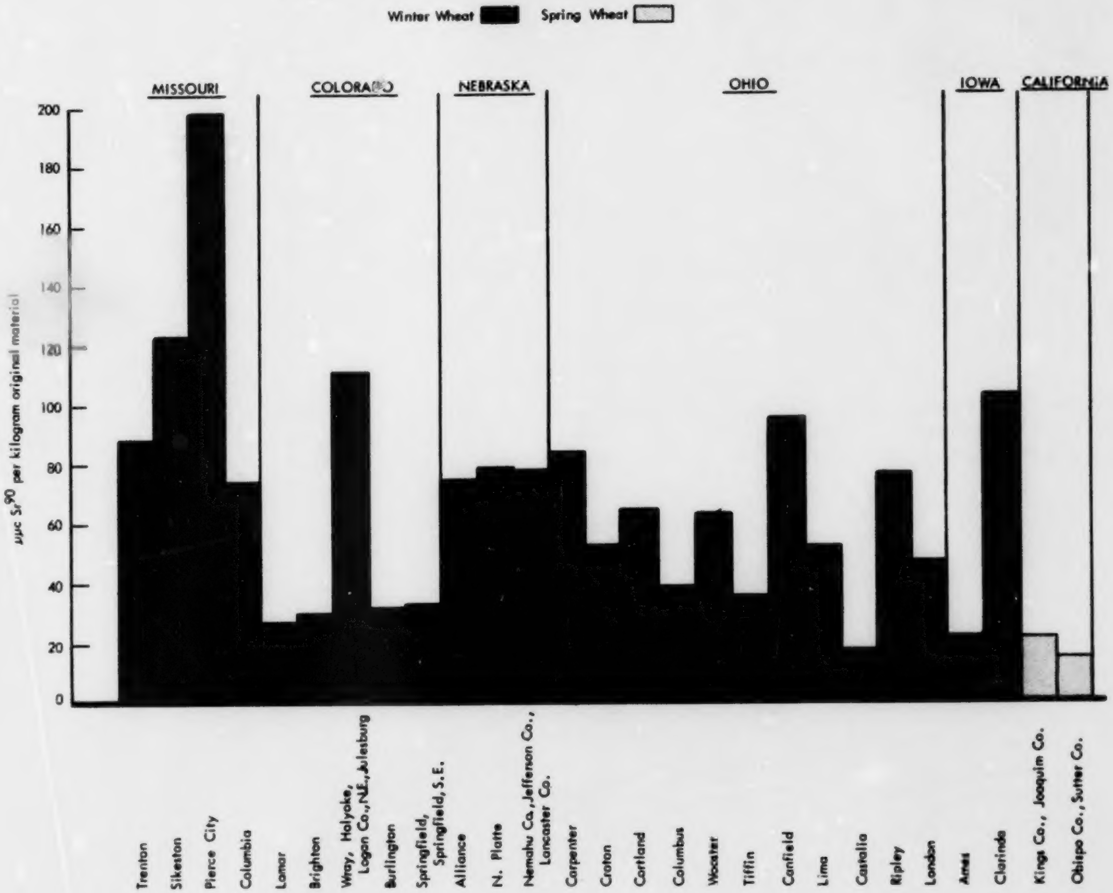


Figure 2. STRONTIUM^{90} IN 1959 WHEAT



MONTEFIORE HOSPITAL METABOLIC STUDIES

U. S. Atomic Energy Commission

Certain special studies not aimed directly at obtaining diet information have been conducted that do provide some data. Doctors Herta Spencer and Joseph Samachson of Montefiore Hospital, New York City, have been conducting some valuable studies on calcium and strontium metabolism. Included in this work has been a measurement of diet and excreta of hospital personnel using current strontium-90 levels in food as a tracer. The diet information, based on an average of 5 subjects during 1959 as reported by AEC's Health and Safety Laboratory, is given in the following table.

TABLE 1.--DIETS OF HOSPITAL PERSONNEL

	kg/day	gmCa/day	$\mu\mu c\ Sr^{90}$/day
Milk	0.88	0.96	9.9
Non-Milk *	1.27	0.17	4.7
Total	2.15	1.13	14.6

$$\text{Ratio: } \frac{14.6\ \mu\mu c\ Sr^{90}}{1.13\ gm\ Ca} = 12.9$$

The non-milk component of the diet was planned to be low in calcium and consisted of the following in kilograms per day: flour and cereal 0.14, meat and fish, 0.36, potatoes 0.10 and fruits and vegetables, 0.67.

SHORT-TERM TRAINING IN RADIOLOGICAL HEALTH

Public Health Service

The Public Health Service through the Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio, routinely conducts short term training courses in Radiological Health for people from State and local health departments, other Federal agencies, industry and enrollees from other countries.

With increased use being made of radiation producing devices and other sources, it has become apparent that a need exists for qualified and trained personnel to evaluate potential radiation exposure in the field of public health. In an effort to cope with this problem the Public Health Service has instituted short-term courses for the purpose of familiarizing representatives of State and local health departments and other individuals charged with the responsibility of evaluating public health hazards. Since the program was launched, over 5,000 individuals have availed themselves of this professional training in all areas of public health activities. New developments in the nuclear field have been extremely rapid and the training affords an opportunity to minimize the time-lag between the development of new procedures and techniques and their application in assessing environmental exposure.

During the past year courses in 14 radiological health subjects were presented to 961 people. The following table outlines the type of courses, the number of times presented and the number of students taking each course.

TABLE 1.–TRAINING COURSES IN RADIOLOGICAL HEALTH CONDUCTED BY THE PUBLIC HEALTH SERVICE

Courses	Length (hours)	Number times given	Total enrollees
Courses Conducted at the Sanitary Engineering Center			
Radiological Health for X-Ray Technicians	40	1	29
Basic Radiological Health	80	6	206
Special Course for Deck Officers of the N.S. Savannah	40	1	22
Radionuclide Protection	40	1	20
X-Ray Protection	40	1	24
Medical Aspects of Radiological Health	80	1	24
Orientation in Radiological Health	80	1	46
Sanitary Engineering Aspects of Nuclear Energy	80	1	36
Reactor Environmental Health Problems	80	1	25
Radionuclides in Foods	80	2	48
Radionuclides in Water	40	1	28
Radioactive Pollutants in Air	40	1	13
Radioactive Pollutants in Water	40	1	33
Sub-Total (Resident)			554
Courses Conducted Away From the Sanitary Engineering Center			
Basic Radiological Health, Amherst, Massachusetts	80	1	33
Dental Radiological Health Gadsen, Alabama Dothan, Alabama Decatur, Alabama Birmingham, Alabama (twice) Mobile, Alabama Tuscaloosa, Alabama Montgomery, Alabama	8	8	356
X-Ray Protection New Brunswick, N. J.	80	1	18
Sub-Total (Field)			407
TOTAL			961

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129<

RADIOLOGICAL HEALTH DATA

MONTHLY REPORT

DECEMBER 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Radiological Health

130<

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing ***Radiological Health Data.*** This publication is issued monthly, with each third issue (starting July 1960) expanded into a quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

TABLE OF CONTENTS

Page

PREFACE iii

SECTION I.—MILK

Public Health Service Milk Monitoring Program 1
  Radioactivity in Milk (July 1960) 3
Strontium-90 in Bovine Milk from Minnesota—State Department of Health 5
Strontium-90 Content in Canadian Dried Milk Products—Department of National Health and Welfare, Ottawa, Canada 6
Radionuclides in Human Milk—Public Health Service 7

SECTION II.—AIR

Public Health Service Radiation Surveillance Network 9
  Radioactivity of Particulates in Air—Gross Beta Counts (July 1960) 11
  Radon and Thoron Measurements (July 1960) 12
Naval Research Laboratory Radioactivity Measurements 12
  Daily Record of Fission Product Beta Activity (July 1960) 13
  Radioactivity Profile (July 1960) 15
Argonne National Laboratory Air Data (April-June 1960)—Atomic Energy Commission 15
Radionuclide Analysis of Cincinnati Surface Air—Public Health Service 16

SECTION III.—WATER

Public Health Service National Water Quality Network 17
  Radioactivity in Raw Surface Waters (June 1960) 19
Strontium-90 in Tap Water (April-June 1960) Atomic Energy Commission 21

SECTION IV.—OTHER DATA

External Gamma Activity (July 1960)--Public Health Service Radiation Surveillance Network 22
Strontium-90 Concentration in Bread Purchased in New York City (March-June 1960)—Atomic Energy Commission 23
Argonne National Laboratory Soil Data (May--June 1960)—Atomic Energy Commission 24
Environmental Levels of Radioactivity at Atomic Energy Commission Installations 24
  Argonne National Laboratory, University of Chicago 24
  Brookhaven National Laboratory, Associated Universities, Inc 26
  Knolls Atomic Power Laboratory, General Electric Company 27
  National Reactor Testing Station, Idaho Operations Office, AEC 31
  Oak Ridge National Laboratory, Union Carbide Nuclear Company 33
  Paducah Atomic Energy Plant, Union Carbide Nuclear Company 39
  Savannah River Plant, du Pont Company 41
  Shippingport Atomic Power Station, Duquesne Light Company 46
Strontium-90 Content of Animal Fodders—Food and Drug Administration 49

INDEX—Volume I 51

SECTION I.—MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The original Public Health Service Milk Monitoring Program consisted of 12 sampling stations. This is being expanded to include an additional 60 stations, of which 46 submitted samples for July. Since the sampling procedures for the original and the added stations are somewhat different, they will be described and reported separately. The Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, continues to conduct the analyses for the original network stations whereas the Public Health Service Southeastern Radiological Health Facility, Montgomery, Alabama, and the Southwestern Radiological Health Facility, Las Vegas, Nevada, provide this service for the added stations.

Publication of the data will normally require a period of about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

Original Stations

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing because it is among the most important components of the diet and is available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs. Since this program has been in operation for over three years, its contribution of information is significant.

The selection of the original sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.

2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.

3. The milk samples were from a supply that was part of a metropolitan milkshed.

4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000-cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000-gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, and the strontium-90 is calculated by measuring the build-up of the daughter decay product, yttrium-90 (after about a two week wait) using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

April through September 1960 issues of Radiological Health Data list references for technical descriptions of the methodology of analyses used.

July data for the original stations are presented in table 1.

Added Stations

133< The Milk Monitoring Program has been expanded to provide additional information on levels of radiation in milk consumed by the public. The new stations are being established in cooperation with State and local health and milk sanitation agencies. The cities have been selected in order to provide adequate coverage from the combined viewpoints of production areas and consuming population. The emphasis on this expanded sampling and radioassay program is that of:

1. Measuring the levels of radionuclides in the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the point of distribution to the public.

2. Providing one sampling point within each state with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of large population groups. This differs from the original set of sampling stations whose selection was based principally upon certain criteria involving the milk production and milkshed area characteristics.

In some instances the designated points are the same as those which reported originally. The establishment of the added sampling stations does not preclude the need for further samples from the selected milksheds serving the same cities. It is important that both networks be in operation for a sufficient period of time to provide an overlap for purposes of comparative study.

The sampling procedure has been developed to give a sample from one day's sales per month in a community which will be as representative of the total supply as can be achieved under practical conditions. The sample will be a composite of those plants supplying not less than 90% of the city's milk supply. The contribution from each plant to the total sample will be approximately proportional to volume of milk sold.

The samples from the added stations are collected with the assistance of the various State and local health and milk sanitation agencies and shipped for analysis to either the Southwestern or Southeastern Radiological Health Facility. The Southeastern Radiological Health Facility processes samples from the 30 states generally east of the Mississippi, and the Southwestern Radiological Health Facility processes samples from the western states.

At the present time radioassays for Sr^{89}, Sr^{90} and Cs^{137} are being performed. Other radionuclides of concern to public health agencies will be included for assay as necessary for complete monitoring of the milk supply.

The data from the Southwestern Radiological Health Facility and the Southeastern Radiological Health Facility for July 1960 are presented in table II.

TABLE I.—RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Robert A. Taft Sanitary Engineering Center

July 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	July	Yearly average	July	Yearly average	July	Yearly average	July	Yearly average	July	Yearly average	July	Yearly average
Atlanta, Ga.	1.10	1.13	ND	<10	ND	< 5	13	15	ND	<10	30	54
Austin, Tex.	1.03	1.09	ND	<10	ND	< 5	3	5	ND	<10	10	23
Chicago, Ill.	1.02	1.09	ND	<10	ND	< 5	9	10	ND	<10	30	39
Cincinnati, Ohio	1.01	1.12	ND	<10	ND	< 5	10	11	ND	<10	25	31
New York, N. Y.	1.02	1.07	ND	<10	ND	< 5	10	10	ND	<10	10	35
Overton, Nev.	0.98	1.08	ND	<10	ND	< 5	2	3	ND	<10	10	17
Sacramento, Calif.	1.02	1.09	ND	<10	ND	< 5	3	4	ND	<10	10	18
Salt Lake City, Utah	1.05	1.10	ND	<10	ND	< 5	4	7	ND	<10	20	38
Spokane, Wash.	1.03	1.11	ND	<10	ND	< 5	10	12	ND	<10	25	51
St. Louis, Mo.	1.12	1.23	ND	<10	ND	< 5	16	21	ND	<10	30	42

Note: Samples are taken at one sampling point from the milk supply of the areas above.
ND—Not detectable by methods used.

TABLE II.--RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program

Added Stations--July 1960

(Radioactivity in $\mu\mu$c/liter)

AREA	Calcium grams/liter		Strontium-89		Strontium-90		Cesium-137	
	July	Average to date[1]	July	Average to date[1]	July	Average to date[1]	July	Average to date[1]
Albuquerque, N. M.	1.06	1.20	ND	<5	4	4	-	-
Austin, Tex.	1.04	1.10	ND	<5	2	2	< 10	10
Boston, Mass.	0.99	1.15	ND	<5	17	16	30	30
Buffalo, N. Y.	1.12	1.26	ND	<5	10	8	10	10
Burlington, Vt.	0.98	1.16	ND	<5	12	11	20	20
Charleston, W. Va.	1.02	1.16	ND	<5	13	10	10	10
Charlotte, N. C.	1.22	1.14	ND	<5	16	15	10	15
Chicago, Ill.	1.04	1.04	ND	<5	8	8	<10	<10
Cleveland, Ohio	0.94	0.94	ND	<5	9	9	<10	<10
Dallas, Tex.	-	1.35	-	<5	-	8	-	<10
Denver, Colo.	1.04	1.20	ND	<5	5	7	-	-
Des Moines, Iowa	1.08	1.10	ND	<5	8	8	20	20
Detroit, Mich.	1.00	1.00	ND	<5	8	8	< 10	≤10
Grand Rapids, Mich.	1.18	1.18	ND	<5	10	10	< 10	<10
Hartford, Conn.	0.99	1.15	10	<5	6	8	20	20
Helena, Mont.	1.15	1.10	ND	<5	5	7	25	25
Honolulu, Hawaii	1.01	1.10	ND	<5	4	4	40	40
Idaho Falls, Idaha	1.15	1.00	ND	<5	5	6	-	-
Indianapolis, Ind.	1.10	1.10	ND	<5	6	6	<10	<10
Kansas City, Mo.	1.06	1.10	ND	<5	6	8	-	-
Laramie, Wyo.	1.02	1.10	ND	<5	3	5	-	-
Las Vegas, Nev.	1.04	1.10	ND	<5	3	3	-	-
Louisville, Ky.	0.97	1.17	5	<5	10	8	<10	<10
Manchester, N. H.	1.00	1.24	ND	<5	14	14	40	40
Milwaukie, Wis.	1.06	1.06	ND	<5	8	8	<10	<10
New Orleans, La.	1.08	1.08	ND	<5	18	18	10	10
New York, N. Y.	0.96	1.10	ND	<5	12	12	10	15
Norfolk, Va.	1.07	1.07	ND	<5	10	10	<10	<10
Oklahoma City, Okla.	1.10	1.10	ND	<5	8	8	<10	<10
Palmer, Alaska	1.16	1.16	ND	<5	5	6	30	30
Philadelphia, Pa.	1.07	1.16	ND	<5	11	10	10	20
Phoenix, Ariz.	1.02	1.02	ND	<5	5	5	15	15
Pittsburgh, Pa.	1.18	1.23	ND	<5	16	15	10	15
Portland, Me.	0.99	1.10	ND	<5	16	16	30	35
Portland, Ore.	1.12	1.10	ND	<5	11	11	70	70
Providence, R. I.	0.98	1.14	ND	<5	14	16	20	20
Salt Lake City, Utah	1.07	1.10	ND	<5	3	7	-	-
San Francisco, Calif.	1.11	1.10	ND	<5	5	6	20	20
San Juan, P. R.	1.06	1.06	ND	<5	4	4	< 10	< 10
Seattle, Wash.	1.10	1.10	ND	<5	7	9	60	60
Spokane, Wash.	1.16	1.10	ND	<5	7	9	-	-
Syracuse, N. Y.	1.18	1.26	ND	<5	8	8	10	15
Trenton, N. J.	1.10	1.18	ND	<5	8	9	< 10	10
Washington, D. C.	1.06	1.06	ND	<5	10	10	10	10
Wichita, Kans.	1.02	1.10	ND	<5	4	6	-	-
Wilmington, Del.	0.99	1.12	ND	<5	10	10	< 10	20

ND--Not detectable by methods used.

[1] Because this program was initiated in 1960 and sampling stations necessarily become operative in a staggered sequence, the averages shown represent all samples taken to date. Averages will normally be for the latest 12 month period after sampling began. For the July data, the average covers a period from one to four months.

STRONTIUM-90 IN BOVINE MILK FROM MINNESOTA

Division of Environmental Sanitation
Minnesota Department of Health

The Minnesota State Department of Health, Division of Environmental Sanitation, initiated a small bovine milk surveillance network in September 1958. Two-ounce samples, collected daily at each of the network stations, are composited and analyzed monthly. Collection is made at the bottling machines so that the sample is randomly representative of the milk produced in that milkshed.

Data for the initial station for the period September 1958 through August 1959 were averaged in the April 1960 issue of Radiological Health Data. Detailed results for the period September 1958 through December 1959 were published in the July 1960 Quarterly Report. The most recently reported data from this network, with Rochester replacing the original station at Faribault, are presented below.

TABLE 1.–STRONTIUM-90 IN BOVINE MILK FROM MINNESOTA

January-April 1960

(Radioactivity in $\mu\mu$c/liter)

Month	Brainerd	Duluth	Minneapolis	Thief River Falls	Worthington	Rochester
January	-	16.3	9.0	10.0	5.9	5.6
February	22.1	16.8	6.8	11.5	6.1	9.3
March	13.4	16.1	7.6	8.9	9.5	5.9
April	17.8	16.6	7.0	12.4	11.0	8.8

137<

STRONTIUM-90 IN CANADIAN DRIED MILK PRODUCTS

The following table presents the results of measurements of strontium-90 in Canadian dried milk for the months of April, May and June 1960. This table was included in the "Quarterly Report of the Radioactive Fallout Study Program," dated September 1960, published by the Radiation Protection Division of the Department of National Health and Welfare, Ottawa, Canada. Figure 1 shows the sampling locations.

Data for the months of January, February and March 1960 were published in the September issue of Radiological Health Data.

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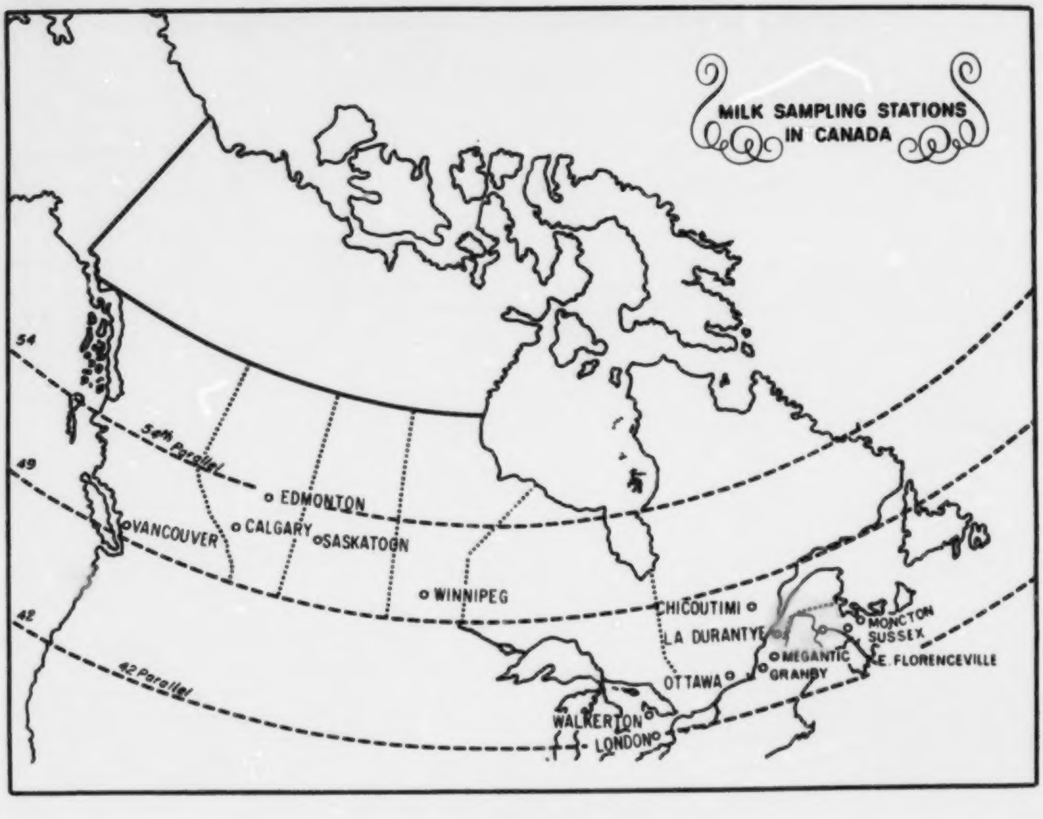

MILK SAMPLING STATIONS
IN CANADA
54
54th Parallel
49
42
42 Parallel
EDMONTON
CALGARY
SASKATOON
VANCOUVER
WINNIPEG
CHICOUTIMI
LA DURANTYE
OTTAWA
MEGANTIC
GRANBY
MONCTON
SUSSEX
E. FLORENCEVILLE
WALKERTON
LONDON

FIGURE 1

472

TABLE 1.—STRONTIUM-90 CONTENT OF CANADIAN DRIED MILK POWDER SAMPLES

(Concentrations in $\mu\mu c$/gm calcium)

Station	April 1960	May 1960	June 1960
Vancouver[1]	14.3	13.4	13.6
Edmonton[1]	15.9	10.3	4.0
Calgary	14.3	14.8	9.3
Saskatoon[2]	13.3	15.6	6.4
Winnipeg[2]	12.0	11.5	[3]N.S.
Walkerton	5.4	5.8	5.4
London[1]	6.9	5.2	4.5
Ottawa[1]	9.2	7.7	5.3
Granby[1]	19.3	21.9	11.7
Megantic	24.7	26.2	16.7
La Durantye	20.5	19.1	12.2
Chicoutimi	18.8	19.3	N.S.
Moncton[1, 2]	13.0	10.7	11.0
Sussex	14.7	13.8	9.9
E. Florenceville	16.9	19.9	12.0
Charlottetown	N.S.	N.S.	N.S.
Average	14.6	14.3	9.4

[1] Natural strontium determinations made for these stations. All other stations were corrected for natural strontium using an average factor of 1.06.

[2] Buttermilk sample. All other samples are skim milk.

[3] N.S.—No milk powder manufactured for the month

Note: Samples collected by Inspectors of the Marketing Division, Department of Agriculture.

RADIONUCLIDES IN HUMAN MILK

Division of Radiological Health
Public Health Service

The Fitzsimmons General Hospital, Denver, Colorado; the United States Army Hospital, Fort Carson, Colorado and the Chicago Board of Health are cooperating with the Division of Radiological Health, Public Health Service in the collection of human milk samples. The object of the project is to determine the relative concentration of strontium-90 and other radionuclides in human milk from selected geographical areas.

The project was begun in Colorado in July 1959 and expanded to include Chicago in December 1959. The samples are collected daily for a monthly composite. The analyses are conducted by the Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Table 1 presents the data from the beginning of the project through June 1960.

TABLE 1.–RADIONUCLIDES IN HUMAN MILK

Sample	Date received	Ca	K	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}
		gm/liter		µµc/liter				
Colorado								
CO-1.............	7/9/59	0.185	0.552	ND	0.7±0.3	-	-	10.8±1.3
CO-2.............	7/17/59	0.220	0.561	ND	0.7±0.3	-	-	-
CO-3.............	11/5/59	0.212	0.664	ND	0.2±0.2	-	-	-
CO-4.............	11/16/59	0.227	0.643	ND	0.4±0.3	ND	ND	20
CO-5.............	11/27/59	0.293	0.618	ND	0.4±0.3	ND	ND	15
CO-6.............	12/16/59	0.277	0.712	ND	0.6±0.2	ND	ND	15
CO-7.............	1/8/60	0.277	0.707	ND	0.5±0.2	ND	ND	5
CO-8.............	1/18/60	0.358	0.777	ND	0.6±0.2	ND	ND	15
CO-9.............	1/19/60	0.183	0.630	ND	0.6±0.2	ND	ND	15
CO-10...........	3/14/60	0.252	0.674	ND	0.7±0.2	ND	ND	ND
CO-11...........	3/16/60	0.218	0.658	ND	0.8±0.2	ND	ND	ND
CO-12...........	5/6/60	0.198	0.508	ND	0.8±0.2	ND	ND	20
Chicago								
CH-1.............	12/21/59	0.293	0.508	ND	0.6±0.2	ND	ND	5
CH-2.............	12/29/59	0.198	0.329	ND	0.4±0.1	ND	ND	10
CH-3.............	1/25/60	0.191	0.534	ND	0.3±0.1	ND	ND	10
CH-4.............	5/19/60	0.190	0.344	ND	1.4±0.4	ND	ND	ND
CH-5.............	6/13/60	0.231	0.251	ND	0.6±0.2	ND	ND	10

ND–Not detectable.
Note: I^{131}, Ba^{140}, Cs^{137} values by gamma spectroscopy except Cs^{137} for Sample CO-1.

SECTION II.—AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

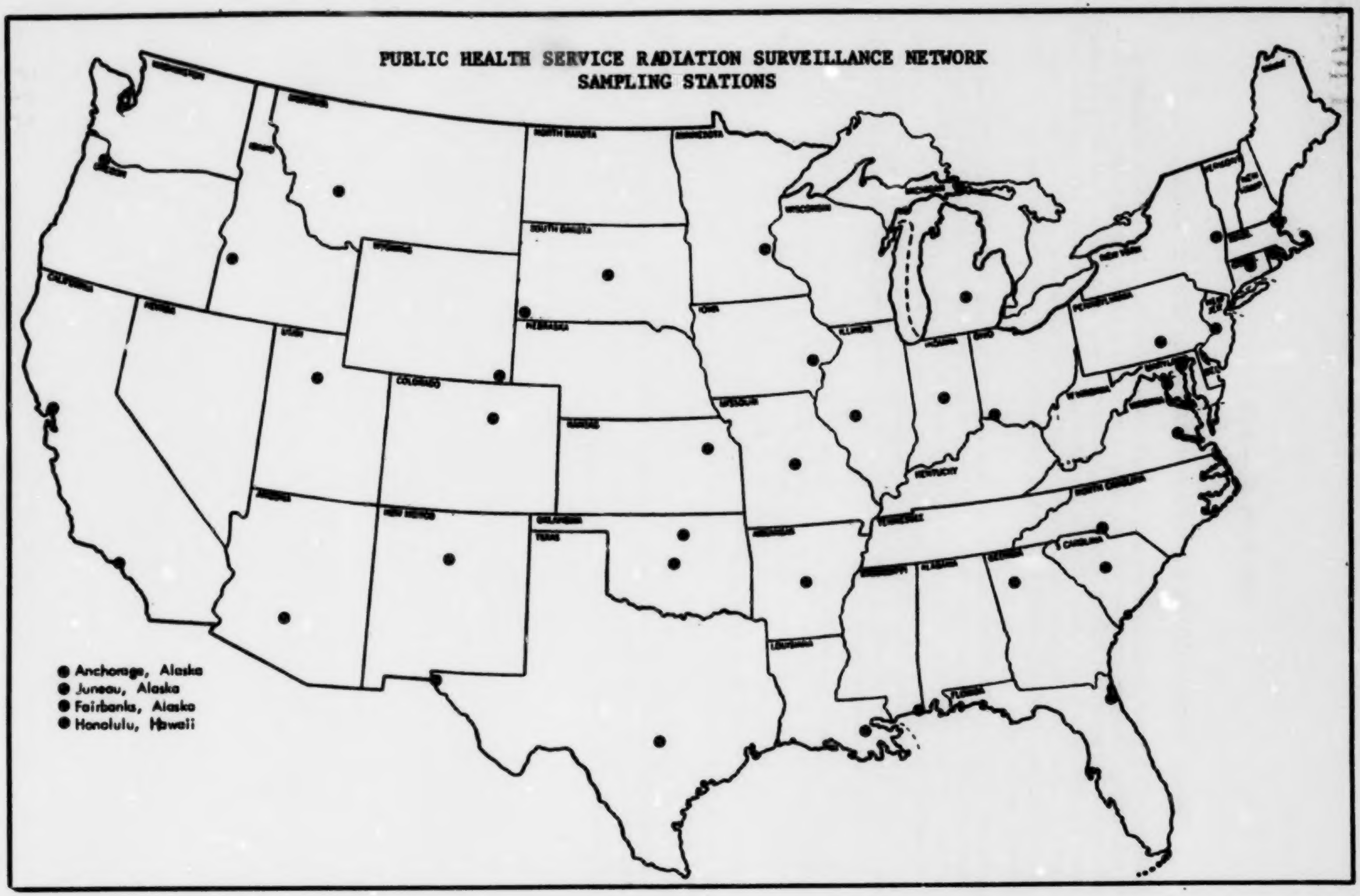
The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout from nuclear weapons tests. Although no nuclear tests have been conducted by the United States since 1958, the program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 45 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 stations operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a know source, using a portable survey meter. The filters are then forwarded to a laboratory in Washington, D. C. for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 45 stations on an average of 70 percent of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85 percent of the stations collect samples of precipitation which are sent to Washington, D. C. for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table 1 presents a summary of the data for July 1960.



PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK
SAMPLING STATIONS

CALIFORNIA
COLORADO
NEW MEXICO
TEXAS
KANSAS
IOWA
ILLINOIS
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
NORTH CAROLINA
S CAROLINA
FLORIDA
NEW YORK
PENNSYLVANIA
● Anchorage, Alaska
● Juneau, Alaska
● Fairbanks, Alaska
● Honolulu, Hawaii

FIGURE 1

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR - GROSS BETA COUNTS

Public Health Service Radiation Surveillance Network

July 1960

Station location	Weighted average $\mu\mu c/m^3$	Maximum $\mu\mu c/m^3$	Minimum $\mu\mu c/m^3$
Alaska, Anchorage	< 0.10	0.14	< 0.10
Alaska, Fairbanks	< 0.11	0.18	< 0.10
Alaska, Juneau	< 0.10	< 0.10	< 0.10
Arizona, Phoenix	< 0.14	0.18	< 0.10
Arkansas, Little Rock	< 0.12	0.20	< 0.10
California, Berkeley	< 0.10	< 0.10	< 0.10
California, Los Angeles	< 0.10	0.12	< 0.10
Colorado, Denver	< 0.14	0.25	< 0.10
Connecticut, Hartford	< 0.14	0.32	< 0.10
District of Columbia	< 0.17	0.31	< 0.10
Florida, Jacksonville	< 0.10	0.11	< 0.10
Georgia, Atlanta	< 0.13	0.22	< 0.10
Hawaii, Honolulu	< 0.10	< 0.10	< 0.10
Idaho, Boise	0.18	0.23	0.17
Illinois, Springfield	< 0.18	0.43	< 0.10
Indiana, Indianapolis	< 0.13	0.20	< 0.10
Iowa, Iowa City	< 0.14	0.20	< 0.10
Kansas, Topeka	< 0.12	0.18	< 0.10
Louisiana, New Orleans	< 0.10	0.10	< 0.10
Maryland, Baltimore	< 0.16	0.25	< 0.10
Massachusetts, Lawrence	< 0.11	0.18	< 0.10
Michigan, Lansing	< 0.12	0.19	< 0.10
Minnesota, Minneapolis	< 0.12	0.16	< 0.10
Mississippi, Pascagoula	< 0.12	0.38	< 0.10
Missouri, Jefferson City	< 0.12	0.17	< 0.10
Montana, Helena	< 0.15	0.22	< 0.10
New Jersey, Trenton	< 0.12	0.27	< 0.10
New Mexico, Santa Fe	< 0.12	0.15	< 0.10
New York, Albany	< 0.12	0.23	< 0.10
North Carolina, Gastonia	< 0.14	0.24	< 0.10
Ohio, Cincinnati	0.78	2.80	0.10
Oklahoma, Oklahoma City	< 0.12	0.20	< 0.10
Oklahoma, Ponca City	< 0.10	0.12	< 0.10
Oregon, Portland	< 0.13	0.23	< 0.10
Pennsylvania, Harrisburg	< 0.15	0.23	< 0.10
Rhode Island, Providence	< 0.15	0.23	< 0.10
South Carolina, Columbia	< 0.12	0.22	< 0.10
South Dakota, Edgemont	-	-	-
South Dakota, Pierre	0.19	0.24	0.13
Texas, Austin	< 0.10	< 0.10	< 0.10
Texas, El Paso	< 0.15	0.34	< 0.10
Utah, Salt Lake City	< 0.13	0.20	< 0.10
Virginia, Richmond	< 0.13	0.18	< 0.10
Washington, Seattle	< 0.10	0.16	< 0.10
Wyoming, Cheyenne	< 0.11	0.15	< 0.10

Values for beta activities in air in Cincinnati are somewhat higher than in other stations in the Radiation Surveillance Network. Reasons may be:

1. Cincinnati uses a membrane type filter with a 20 liters per minute flow rate, compared to a cellulose type filter at other stations sampling 1,500 liters per minute.
2. Variations in counting equipment.
3. Samples are counted at Cincinnati within one day after collection, whereas the samples from other stations are counted several days later in Washington. Thus, Cincinnati values may incorporate natural beta activity from thoron daughters.

Although the relative contribution from each of these parameters has yet to be evaluated, it is recognized that some of them probably play a much more significant role than others.

143<

TABLE 2.-RADON AND THORON MEASUREMENTS

Public Health Service Radiation Surveillance Network Station at Cincinnati, Ohio

July 1960

Date	Continuous Sample Collection			Radon(a) PM $\mu\mu c/m^3$	Radon(b) AM $\mu\mu c/m^3$	Thoron(c) $\mu\mu c/m^3$	Beta(d) activity $\mu\mu c/m^3$
	Sample change time	Sampling period (hours)	Volume m^3				
July 1........	0817	23.8	28.7	(e)	(e)	(e)	0.3
5........	1030	98.2	116.7	66	155	3.4	0.4
6........	0810	21.6	25.8	111	523	4.5	1.8
7........	0808	23.9	29.0	106	435	3.8	1.2
8........	0814	24.0	28.9	134	862	7.2	0.1 (3)
11........	0808	71.9	85.0	136	367	2.8	0.5
12........	0820	24.1	28.6	192	903	5.8	2.0
13........	0811	23.8	28.3	219	738	8.3	2.8
14........	0815	24.0	28.4	57	100	1.4	0.5
15........	0815	23.9	28.5	58	440	2.9	0.2 (3)
18........	0815	71.9	85.0	210	798	8.6	0.9
19........	0815	23.9	28.1	151	648	6.5	2.1
20........	0830	24.2	27.9	158	451	5.1	2.0
21........	0825	23.9	28.5	77	326	4.4	1.3
22........	0820	23.9	29.1	199	720	9.5	0.4 (3)
25........	0816	71.9	86.7	190	763	7.4	0.4
26........	0815	23.9	29.1	131	465	5.3	0.7
27........	0817	24.0	29.2	115	293	2.2	0.7
28........	0817	23.9	29.1	182	595	4.0	1.3
29........	0815	23.9	27.5	166	962	7.5	0.2 (3)
	Average................................			140	612	5.7	0.8

(a) Filters are temporarily withdrawn from sampler at about 3 p.m. and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 A.M. the following day.

(b) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(c) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

(d) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

(e) Counter out of order during this period.

NAVAL RESEARCH LABORATORY RADIOACTIVITY MEASUREMENTS

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during July 1960 is shown in table 1, while the radioactivity profile for the same month is shown in Figure 1. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site. (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter).

TABLE 1.–DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION

144<

U. S. Naval Research Laboratory

July 1960

(Disintegrations/minute per cubic meter of air)

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador
1	-	0.02	0.07	0.10	0.05	0.01	0.02
2	-	0.03	0.04	0.07	0.05	0.04	0.02
3	-	0.03	0.04	0.07	0.05	0.04	0.02
4	-	0.03	0.04	0.07	0.05	0.04	0.07
5	-	0.03	0.03	0.08	0.07	0.04	0.07
6	-	0.03	0.03	0.08	0.07	0.04	0.07
7	-	0.03	0.11	0.07	0.07	0.02	0.07
8	-	0.03	0.11	0.07	0.07	0.02	0.05
9	-	0.02	0.11	0.09	0.04	0.01	-
10	-	0.02	0.11	0.09	0.04	0.01	-
11	-	0.02	0.11	0.09	0.04	0.01	-
12	-	0.03	0.09	0.14	0.06	0.04	-
13	-	0.03	0.09	0.14	0.06	0.04	-
14	-	0.03	0.08	0.09	0.03	0.06	-
15	-	0.03	0.08	0.09	0.03	0.06	-
16	-	0.03	0.09	0.05	0.03	0.05	-
17	-	0.03	0.09	0.05	0.03	0.05	-
18	-	0.03	0.09	0.05	0.05	0.05	-
19	-	0.00	-	0.14	0.05	0.01	-
20	-	0.00	-	0.14	0.05	0.01	-
21	-	0.02	-	0.15	0.03	0.06	-
22	-	0.02	-	0.15	0.03	0.06	-
23	-	0.04	-	0.11	0.04	0.01	-
24	-	0.04	-	0.11	0.04	0.01	-
25	-	0.04	-	0.11	0.04	0.01	-
26	-	0.02	-	0.09	0.04	0.10	-
27	-	0.02	-	0.09	0.04	0.10	-
28	-	0.01	-	0.07	0.06	0.03	-
29	-	0.01	-	0.07	0.06	0.03	-
30	-	0.01	-	0.07	0.07	0.09	-
31	-	0.01	-	0.07	0.07	0.09	-
Mean value	-	0.02	0.08	0.09	0.05	0.04	-

479

145<

TABLE 1.–DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION–Con.

U. S. Naval Research Laboratory

July 1960

(Disintegrations/minute per cubic meter of air)

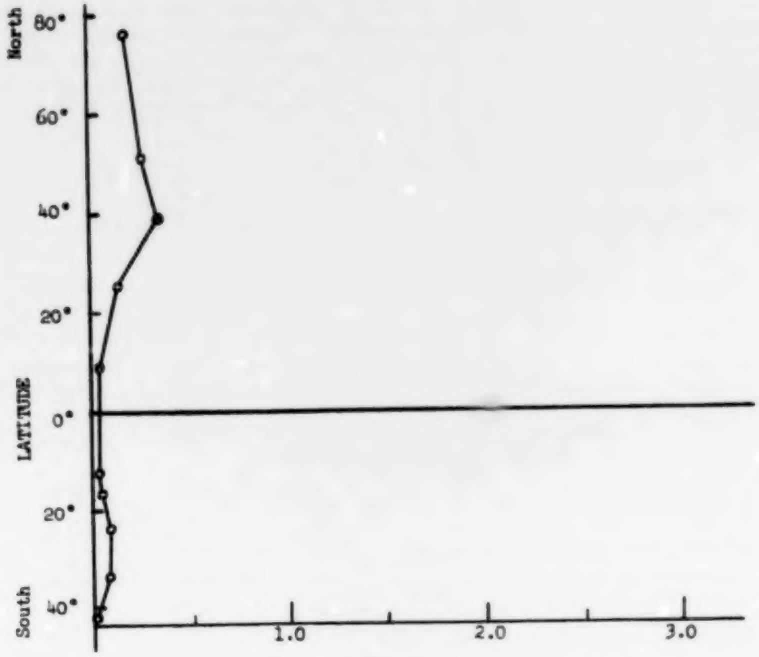
Day	Mira-flores, Panama Canal	Mauna Loa, Hawaii	Miami, Florida	Washing-ton, D. C.	Moosonee, Ontario, Canada	Thule Green-land	Bravo, Artic Ice Floe
1	0.06	0.64	0.22	0.55	0.34	0.17	0.02
2	0.08	0.71	0.18	0.29	0.23	0.17	0.02
3	0.08	0.71	0.18	0.29	0.23	0.17	0.02
4	0.08	0.71	0.18	0.29	0.23	0.17	0.02
5	0.07	0.35	0.16	0.53	0.12	0.18	0.03
6	0.04	0.35	0.16	0.53	0.12	0.18	0.03
7	0.04	0.22	0.19	0.37	0.47	0.20	0.03
8	0.04	0.22	0.19	0.37	0.47	0.20	0.03
9	0.08	0.17	0.10	0.14	0.36	0.08	0.03
10	0.08	0.17	0.10	0.14	0.36	0.08	0.03
11	0.08	0.17	0.10	0.14	0.36	0.08	0.03
12	0.09	0.19	0.16	0.48	0.20	0.18	0.04
13	0.09	0.19	0.16	0.48	0.20	0.18	0.04
14	0.05	0.12	0.14	0.23	0.24	0.29	0.04
15	0.05	0.12	0.14	0.23	0.24	0.29	0.04
16	0.03	0.16	0.22	0.36	0.32	0.25	0.04
17	0.03	0.16	0.22	0.36	0.32	0.25	0.04
18	0.03	0.16	0.10	0.36	0.32	0.25	0.04
19	0.07	0.12	0.10	0.50	0.14	0.25	-
20	0.07	0.12	0.10	0.50	0.14	0.25	-
21	0.03	0.22	0.19	0.22	0.29	0.17	-
22	0.03	0.22	0.19	0.22	0.29	0.17	-
23	0.05	0.15	0.09	0.27	0.29	0.17	-
24	0.05	0.15	0.09	0.27	0.29	0.17	-
25	0.05	0.15	0.09	0.27	0.29	0.17	-
26	0.05	0.07	0.03	0.35	0.12	0.10	-
27	0.05	0.07	0.03	0.35	0.12	0.10	-
28	0.02	0.03	0.03	0.35	0.34	0.10	-
29	0.02	0.03	0.03	0.35	0.34	0.10	-
30	0.03	0.09	0.07	0.37	0.26	0.10	
31	0.03	0.09	0.07	0.37	0.26	0.54	-
Mean value	0.05	0.23	0.13	0.34	0.27	0.18	0.03

480

AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS ALONG THE 80TH MERIDIAN (WEST)

U. S. Naval Research Laboratory

July 1960



AVERAGE FISSION PRODUCT CONCENTRATION (d/m per Cubic Meter of Air)

FIGURE 1

ARGONNE NATIONAL LABORATORY AIR DATA

U. S. Atomic Energy Commission

Air filter measurements of ground level air at Argonne National Laboratory, Lemont, Illinois, for September 1959 through March 1960 were reported in the August 1960 issue of Radiological Health Data. The table below gives the cesium-137 activity for the second quarter of 1960. Other fission products, rhodium-102 and tungsten-185 showed similar trends. The peak concentrations appear in April 1960. These data were reported to the Atomic Energy Commission by Dr. Philip F. Gustafson.

TABLE 1.--AIR CONCENTRATION OF CESIUM-137 AT ARGONNE NATIONAL LABORATORY

Second Quarter 1960

Month	Activity $\mu\mu c/m^3$
April....................	4.8×10^{-3}
May.....................	3.7×10^{-3}
June......................	2.9×10^{-3}

147<

RADIONUCLIDE ANALYSIS OF CINCINNATI SURFACE AIR

Analyses have been performed at the Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio, to determine specific radionuclide content of the air in that area for the period of the second week in February 1959 through May 1959. The analyses[1] were conducted by processing one composite sample of 83 millipore filters used by the Cincinnati station of the Public Health Service Radiation Surveillance Network for collecting 24 hour daily air samples. The entire ashed sample was analyzed by gamma spectroscopy for identification of the gamma emitting radionuclides. An aliquot was then taken for radiochemical analyses. The radionuclide content of the ash, as analyzed and correlated to the total volume of air drawn through the filters, is presented in the following table. The data show that cerium-141/144, zirconium-95 and ruthenium-103/106 comprised most of the activity in this composite of Cincinnati surface air.

TABLE 1.–RADIONUCLIDE CONTENT OF CINCINNATI SURFACE AIR

Nuclide	Activity pc/m^3	Critical organ
Strontium-89	0.18	Bone; Lung
Strontium-90	0.04	Bone
Cesium-137	0.26	Lung
Zirconium-95 (not including Niobium-95)	0.64	Lung
Ruthenium-103/106 (including Rhodium-103/106)	0.50	Lung
Cerium-141/144 (including praseodymium-144)	1.44	Lung
Trivalent Rare Earths (not including yttrium)	0.14	Bone
Zinc-65	0.04	Lung
Cobalt-60	0.16	Lung
Mangances-54	<0.04	Lung

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[1] Chemical procedures are presented in the complete report entitled "Radionuclide Analysis of Cincinnati Air," dated September 26, 1960, by R. J. Velton and H. L. Kreiger, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio.

482

SECTION III.—WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provision of Section 4 (c) of Public Law 660, which states "...The Surgeon General shall ... collect and disseminate basic data ... (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State local health agencies, was started in October 1957. At present there are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing, beta activity in most raw waters is generally approaching a level attributable solely to natural beta activity. Natural beta activity can be two or three times the natural alpha activity based on the same nuclides being present. Some exceptions to this are seen, notably the data for the Columbia River and the Animas River. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than one week. Beginning with samples taken in January 1960, beta determinations were performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

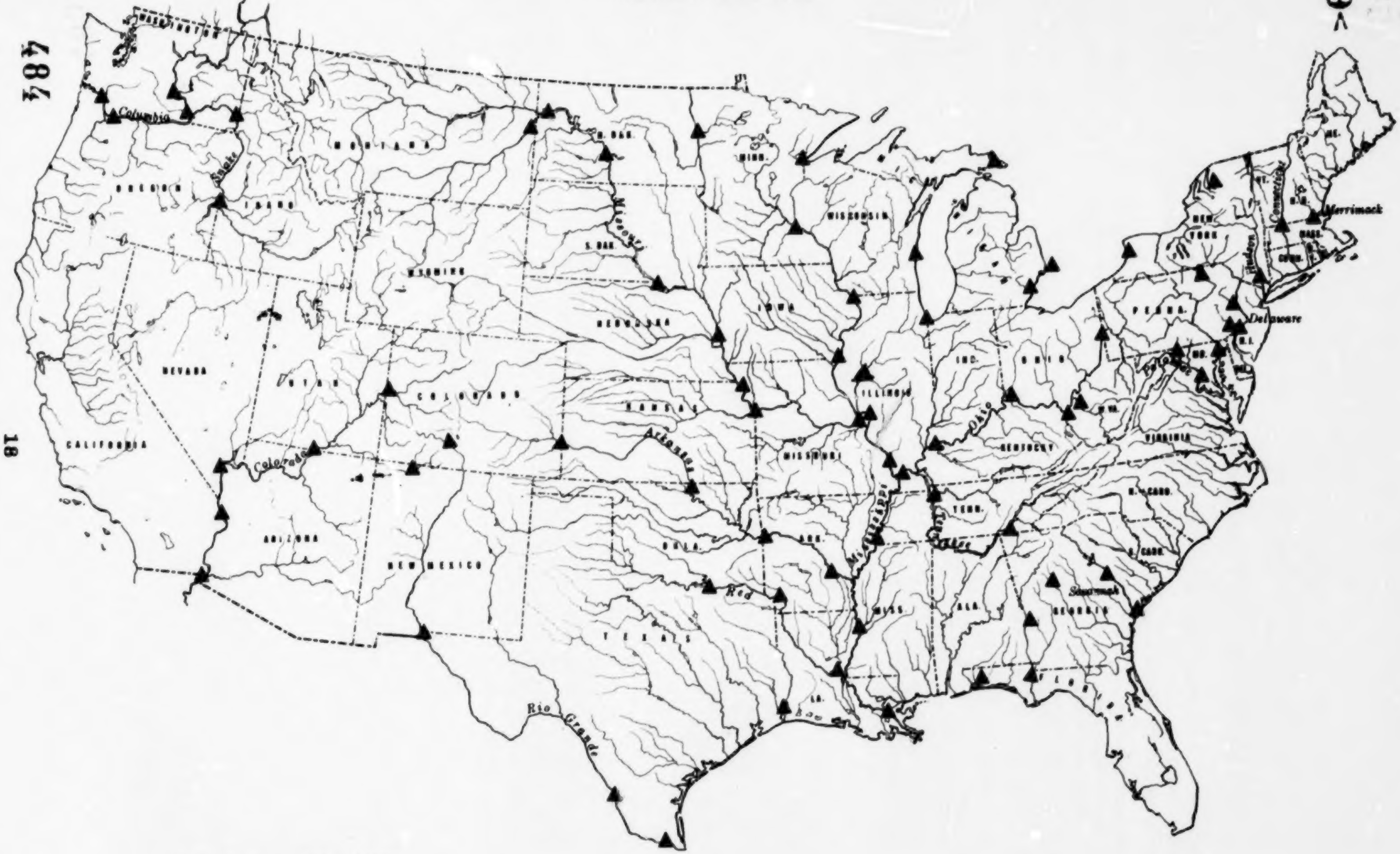
Strontium-90 data are reported as being the results of determinations on composite samples for a three-month period ending in the month shown.

Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167-169.

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK
SAMPLING STATIONS


WASHINGTON
Columbia
Snake
OREGON
IDAHO
MONTANA
N. DAK.
S. DAK.
Missouri
MINN.
WISCONSIN
WYOMING
NEBRASKA
IOWA
NEVADA
UTAH
COLORADO
KANSAS
Arkansas
CALIFORNIA
Colorado
ARIZONA
NEW MEXICO
OKLA.
Red
TEXAS
Rio Grande
MISSOURI
ILLINOIS
IND.
OHIO
Ohio
KENTUCKY
TENN.
Tennessee
Mississippi
ARK.
MISS.
ALA.
LA.
GEORGIA
Savannah
FLORIDA
S. CARO.
N. CARO.
VIRGINIA
W. VA.
PENNA.
NEW YORK
Delaware
Hudson
Connecticut
Merrimack
ME.
VT.
N.H.
MASS.
CONN.
N.J.
MD.

As of June 30, 1960

FIGURE 1

TABLE I. –RADIOACTIVITY IN RAW SURFACE WATERS
Public Health Service National Water Quality Network
(Micromicrocuries per liter)

Station	Quarter ending 6/30/60	June, 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ANIMAS RIVER							
Cedar Hill, N. Mex.	0.3	10	2	12	6	2	8
ARKANSAS RIVER							
Coolidge, Kans.	1.1	-	-	-	-	-	-
Ponca City, Okla.	1.3	6	0	6	11	2	13
Fort Smith, Ark.	1.1	41	4	45	11	2	13
Pendleton Ferry, Ark.	1.2	21	0	21	14	0	14
CHATTAHOOCHIE RIVER							
Atlanta, Ga.	(*)	0	0	0	0	0	0
Columbia, Ga.	0.5	0	1	1	0	0	0
COLORADO RIVER							
Loma, Colo.	0.3	8	0	8	5	3	8
Page, Ariz.	0.9	18	0	18	10	3	13
Hoover Dam, Ariz.-Nev.	1.3	0	0	0	0	4	4
Parker Dam, Ariz.-Calif.	0.4	0	0	0	<1	5	6
Yuma, Ariz.	1.0	0	0	0	2	2	4
COLUMBIA RIVER							
Pasco, Wash.	0.3	22	156	178	0	0	0
Wenatchee, Wash.	0.3	0	0	0	0	0	0
Bonneville Dam, Ore.	(*)	8	69	77	-	-	-
Clatskanie, Ore.	0.3	-	-	-	-	-	-
CONNECTICUT RIVER							
Northfield, Mass.	(*)	0	0	0	0	0	0
DELAWARE RIVER							
Martin's Creek, Pa.	0.4	0	3	3	0	0	0
Philadelphia, Pa.	0.3	1	0	1	6	0	6
GREAT LAKES							
Duluth, Minn.	0.3	0	0	0	0	0	0
Detroit, Mich.	0.6	0	0	0	0	1	1
Buffalo, N. Y.	0.7	0	2	2	0	0	0
HUDSON RIVER							
Poughkeepsie, N. Y.	0.7	<1	1	2	1	0	1
ILLINOIS RIVER							
Peoria, Ill.	0.8	0	0	0	<1	1	2
KANAWHA RIVER							
Winfield Dam, W. Va.	0.3	0	0	0	0	<1	<1
MISSISSIPPI RIVER							
Red Wing, Minn.	1.5	1	0	1	0	1	1
Dubuque, Iowa	(*)	0	6	6	0	0	0

TABLE I.—RADIOACTIVITY IN RAW SURFACE WATERS—Con.

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending 6/30/60	June 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
MISSISSIPPI RIVER—Con.							
Burlington, Iowa	(*)	20	24	41	4	1	5
East St. Louis, Ill.	1.2	12	4	16	5	0	5
Cape Girardeau, Mo.	0.9	32	17	49	17	1	18
West Memphis, Ark.	0.9	6	6	12	7	0	7
Delta, La.	(*)	0	0	0	5	2	7
New Orleans, La.	1.0	12	6	18	8	1	9
MISSOURI RIVER							
Williston, N. D.	0.7	7	6	13	5	2	7
Bismarck, N. D.	0.9	0	3	3	0	5	5
Yankton, S. D.	1.0	0	4	4	0	1	1
Omaha, Nebr.	0.6	20	14	34	0	5	5
St. Joseph, Mo.	0.9	-	-	-	-	-	-
Kansas City, Kans.	0.9	49	0	49	17	0	17
St. Louis, Mo.	1.0	58	9	67	12	2	14
OHIO RIVER							
East Liverpool, O.	1.9	0	0	0	0	0	0
Wheeling, W. Va.	-	10	10	20	0	0	0
Huntington, W. Va.	0.3	6	8	14	1	0	1
Cincinnati, O.	0.6	4	3	7	0	0	0
Evansville, Ind.	0.4	27	0	27	-	-	-
Cairo, Ill.	0.7	0	32	32	0	1	1
POTOMAC RIVER							
Williamsport, Md.	0.8	0	0	0	0	1	1
Great Falls, Md.	0.5	0	16	16	2	0	2
RED RIVER							
Denison, Tex.	1.2	0	0	0	0	0	0
Index, Ark.	1.2	4	25	29	4	1	5
Alexandria, La.	0.7	19	20	39	8	2	10
RIO GRANDE RIVER							
El Paso, Tex.	1.4	28	0	28	0	0	0
Laredo, Tex.	1.0	0	0	0	0	4	4
Brownsville, Tex.	0.7	0	0	0	-	-	-
SABINE RIVER							
Ruliff, Tex.	(*)	3	0	3	<1	<1	<1
ST. CLAIR RIVER							
Port Huron, Mich.	(*)	<1	1	1	0	1	1
ST. LAWRENCE RIVER							
Massena, N. Y.	0.6	0	4	4	0	0	0

TABLE I.—RADIOACTIVITY IN RAW SURFACE WATERS—Con.

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending 6/30/60	June 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	1.	0	<1	<1	0	0	0
SCHUYLKILL RIVER							
Philadelphia, Pa.	0.7	0	0	0	<1	0	<1
SAVANNAH RIVER							
Port Wentworth, Ga.	0.8	<1	2	3	-	-	-
SNAKE RIVER							
Wawawai, Wash.	0.3	0	2	2	0	0	0
Weiser, Idaho	0.5	0	0	0	-	-	-
SUSQUEHANNA RIVER							
Sayre, Pa.	0.4	0	8	8	0	<1	<1
Conowingo, Md.	0.2	1	1	2	<1	0	<1
TENNESSEE RIVER							
Chattanooga, Tenn.	1.3	0	16	16	0	0	0
YELLOWSTONE RIVER							
Sidney, Mont.	0.3	18	2	20	5	3	8

*Insufficient sample for analysis.

STRONTIUM-90 IN TAP WATER

The Atomic Energy Commission's Health and Safety Laboratory monitors the tap water for Richmond, California and New York City for strontium-90 on a monthly basis. The data for the second quarter are presented below. Data for the first quarter were given in the August 1960 issue of Radiological Health Data.

TABLE 2.—STRONTIUM-90 IN TAP WATER

Second Quarter 1960

Location	Month	Activity $\mu\mu c$/liter	Sr^{89}/Sr^{90} at midpoint of sampling month
Richmond, California (40 liters per sample)	April May June	0.264 0.253 0.265	0.3 0.4 0.1
New York City (100-200 liters per sample)	April May June	0.27 0.59 0.42	- - -

153<

SECTION IV.—OTHER DATA

EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variance anticipated due to differences in normal background and in instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

July 1960

Station location	Average* mr/hr	Station location	Average* mr/hr
Alaska, Anchorage	0.01	Mississippi, Pascagoula	(**)
Alaska, Fairbanks	0.01	Missouri, Jefferson City	0.01
Alaska, Juneau	0.02	Montana, Helena	0.03
Arizona, Phoenix	0.01	New Jersey, Trenton	0.02
Arkansas, Little Rock	0.02	New Mexico, Santa Fe	0.04
California, Berkeley	0.01	New York, Albany	0.02
California, Los Angeles	0.01	North Carolina, Gastonia	0.02
Colorado, Denver	0.02	Ohio, Cincinnati	(**)
Connecticut, Hartford	0.02	Oklahoma, Oklahoma City	0.02
District of Columbia	0.02	Oklahoma, Ponca City	0.04
Florida, Jacksonville	0.02	Oregon, Portland	0.02
Georgia, Atlanta	0.02	Pennsylvania, Harrisburg	0.01
Hawaii, Honolulu	0.02	Rhode Island, Providence	0.02
Idaho, Boise	0.02	South Carolina, Columbia	0.02
Illinois, Springfield	0.01	South Dakota, Edgemont	(**)
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.02	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.01	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	(**)
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02
Minnesota, Minneapolis	0.01		

*Readings taken 3 feet above ground.
**No data received.

488

154<

STRONTIUM-90 CONCENTRATION IN BREAD PURCHASED IN NEW YORK CITY

Health and Safety Laboratory
U. S. Atomic Energy Commission

The October 1960 issue of Radiological Health Data presented data on the concentration of strontium-90 in bread purchased in New York City for 1958, May 1959 and the first two months of 1960. The following table gives the data for March through June of 1960. One loaf of each type is purchased daily from a local grocer and the loaves composited on a monthly basis. Five brands are represented in each month's sample. No appreciable change in the strontium-90 concentration in whole wheat and white bread from January and February 1960 values is noted.

TABLE 1.—STRONTIUM-90 AND CALCIUM IN BREAD PURCHASED IN NEW YORK CITY

March-June 1960[1]

Sampling period	Calcium	Strontium-90		
	gm/kg of original material	μμc/gm Ca	μμc/kg of original material	μμc/daily intake[2]
	Whole Wheat Bread			
March	0.68	30	21	0.08
April	0.66	32	21	0.08
May	0.83	34	29	0.1
June	0.98	29	28	0.1
	White Bread			
March	0.74	13	9.5	0.44
April	0.73	13	9.6	0.44
May	0.88	13	11	0.51
June	1.30	7.8	10	0.46

[1] Data taken from Quarterly Summary Report, HASL-95, Dated October 1, 1960.

[2] Calculated values from U. S. Department of Agriculture data on average daily per capita consumption of 3.6 gm/day of whole wheat bread and 46.2 gm/day of white bread. (See Radiological Health Data, August 1960.)

155<

ARGONNE NATIONAL LABORATORY SOIL DATA

U. S. Atomic Energy Commission

Dr. Philip F. Gustafson has reported further fission product radioactivity in soil samples at Argonne National Laboratory, Lemont, Illinois. Previous data were reported in Radiological Health Data, July 1960.

Isotope	May 13, 1960 mc/mi²	June 30, 1960 mc/mi²
Zr^{95} Nb^{95}............	80	45
Cs^{137}....................	187	191
Ru^{106}....................	890	830
Ce^{144}....................	1,200	1,280
Totals............	2,437	2,391
Dose-rate (μrad/hr)*	1.97	1.71

*Calculated dose-rate at one meter above ground surface. No correction is made for shielding effect of structures.

ENVIRONMENTAL LEVELS OF RADIOACTIVITY AT ATOMIC ENERGY COMMISSION INSTALLATIONS

The United States Atomic Energy Commission is providing data on environmental levels of radioactivity in the vicinity of major Commission installations to the Public Health Service on a quarterly basis. The data are from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

The November 1960 issue of Radiological Health Data summarized the 1959 and the first quarter of 1960 reports for seven of the installations. Reports for eight more installations for this same period are included in the following section.

ARGONNE NATIONAL LABORATORY

University of Chicago
Lemont, Illinois
Issued July 1960

Argonne National Laboratory (ANL) has made measurements of the radioactivity on the Laboratory grounds and in the area around the Laboratory since 1948. This is done primarily to determine if the work conducted at Argonne contributes to the natural radioactive content of the environment. The results of this program from 1948 through 1958 have been published annually in the form of Argonne National Laboratory Reports. This report gives the data on the amount of radioactive materials added to the environment in 1959 and in the first quarter of 1960 as a result of ANL operations.

Air samples were collected on the Argonne grounds and at four locations from 10 to 30 miles from the Laboratory and the radioactivity measured. No radioactivity originating at ANL was detected in any of the air samples.

Argonne National Laboratory waste water is discharged into Sawmill Creek, a small stream that runs through the ANL grounds and enters the Des Plaines River about 500 yards downstream from the waste water discharge. This is the only location off the Laboratory grounds where activity attributable to ANL operations was found. This activity consisted principally of uranium, uranium decay products and cobalt-58. During the period covered by this report the average uranium concentration in the Creek downstream from the waste water discharge was approximately 40 $\mu\mu$c per liter, or 0.2% of the maximum permissible concentration (MPC). The corresponding average for cobalt-58 was about 10 $\mu\mu$c

490

per liter, or 0.01% of the MPC. In addition, smaller amounts of plutonium and a few fission products were detected occasionally below the waste water discharge. The concentrations of these isotopes were also a very small fraction of the MPC.

The radioactivity in the Des Plaines River was measured at several locations above and below the mouth of Sawmill Creek to determine the effect of the creek on the radioactive content of the Des Plaines River. As a result of dilution, the activity in Sawmill Creek had no detectable effect on the radioactivity in the Des Plaines River.

TABLE 1.—AVERAGE RADIOACTIVITY IN AIR FILTER SAMPLES, 1953-59*

(μμc/m³)

Year	Alpha activity	Beta activity
1953	0.010	1.2
1954	.010	0.4
1955	.007	0.8
1956	.010	1.3
1957	.008	2.1
1958	.007	2.8
1959	.006	2.3

*From 1953 through 1956 samples were collected only on the Argonne site. Off-site air sampling was begun in 1957, and the results for 1957, 1958 and 1959 are the averages of samples collected both on and off the Argonne site.

TABLE 2.—RADIOACTIVITY IN AIR FILTER SAMPLES

(Average concentrations in μμc/m³)

Activity	Calendar year 1959		First quarter 1960	
	On ANL site	Near ANL site	On ANL site	Near ANL site
Alpha	0.006	0.006	0.003	0.004
Beta	2.2	2.3	0.10	0.10

TABLE 3.—URANIUM AND PLUTONIUM IN SAWMILL CREEK,
First Quarter 1960

(Average concentrations in μμc/liter)

Location	Total Beta*	Uranium	Plutonium
Above ANL site	7.0	2.1	<0.05**
Below waste water discharge	49	126	0.3

*The beta activity added to the creek in Argonne waste water was almost entirely due to uranium daughters and cobalt-58.

**All of the samples analyzed from this location contained less than 0.05 μμc of plutonium per liter. This value is the smallest amount that can be detected by the analytical method used.

491

157

BROOKHAVEN NATIONAL LABORATORY

Associated Universities, Incorporated
Upton, New York
Issued July 1960

Regular measurements have been made of the effect of operations on the environmental levels of radioactivity in the vicinity of Brookhaven National Laboratory (BNL) since the establishment of the Laboratory in 1947. This report presents data for 1959 and the first quarter of 1960.

Operations at BNL affect the natural radiation background in the vicinity of the Laboratory in two ways:

1. The cooling air from the research reactor contains a substantial quantity of argon-41 (half-life 110 minutes). This gas, present in a large volume of air, is released from a 300 foot high stack and is further diluted by the atmosphere. The effect of radioactive argon from the reactor stack during 1959 and first quarter 1960 is shown in table 1.
2. Liquid wastes produced by Laboratory operations contain a variety of radioactive substances at very low levels of activity. These wastes are filtered, chlorinated and released to a small stream that forms one of the headwaters of the Peconic River.

TABLE 1.—RADIATION LEVELS AT SITE BOUNDARY DUE TO LABORATORY OPERATIONS

(Average values in mr/week, from argon-41 in reactor cooling air)

Period	N. Gate*	S. W. perimeter	S. E. perimeter	N. E. perimeter
Calendar year 1959.....	0.46	0.22	0.39	0.84
First quarter 1960......	0.22	.35	.69	.31

*This station is 680 meters inside the site boundary.

The limit recommended by the National Committee on Radiation Protection for radiation levels at the edge of the controlled area of a laboratory such as BNL is 10 milliroentgens per week, averaged over a year. Thus, the highest average level shown in table 1, i.e., 0.84 mr/week, is far below the permissible limit. The gross radiation level in this area as measured by the monitoring stations, averaged 3.8 mr/week during 1959 and 2.7 mr/week during the first quarter 1960. In each case, about 1.7 mr/week is due to natural radiation and the rest is due to fallout from nuclear weapons tests. It is pertinent to note that the station for which the highest value was obtained is located in the direction for which a maximum average level is to be expected from meteorological considerations.

The gross concentration and amount of radioactivity in the laboratory liquid waste effluent where it leaves the site, is shown in table 2.

TABLE 2.—LIQUID WASTE EFFLUENT LEAVING THE BNL SITE

Period	Volume gal/day	Concentration of activity $\mu\mu$c/liter	Total activity millicuries
Calendar year 1959.....	1,745,000	79	144
First quarter 1960......	494,000	130	21

If the BNL waste effluent were to be used as drinking water, the applicable limit on the concentration, in accordance with the recommendations of the NCRP, would be 600 $\mu\mu$c/liter. However, the effluent is not used for drinking and undergoes considerable additional dilution as it progresses downstream. Thus, the concentration values shown in table 2 are relatively small compared to the permissible concentrations.

492

KNOLLS ATOMIC POWER LABORATORY

General Electric Company
Schenectady, New York
Issued July 1960

The Knolls Atomic Power Laboratory (KAPL) has been operated by the General Electric Company for the Atomic Energy Commission since 1946. The principal task of the Laboratory is to support the Commission's Naval Reactors Program in the development of atomic power reactors for naval propulsion. This task includes design, construction and prototype operation of nuclear power reactors.

The Knolls Atomic Power Laboratory consists of two sites, the Knolls Site and the West Milton Site. (See figure 1 for geographical locations.) The former is located 5 miles east of Schenectady, New York, on the south bank of the Mohawk River. It consists of approximately 170 acres, upon which are located administrative buildings; chemistry, physics, metallurgical, engineering, and radioactive materials laboratories; critical assembly buildings; machine shops; decontamination facilities; radioactive waste storage and processing facilities; nuclear fuel storage and assembly buildings. The West Milton Site is located approximately 18 miles north of Schenectady, in Saratoga County, occupying some 4,000 acres. Principal facilities include the Triton prototype reactor, equipment service building, fuel service building and waste treatment facility. In addition, there are administration and utility service buildings. There is also a containment-sphere in which a destroyer prototype reactor now is being constructed.

The Knolls Atomic Power Laboratory releases small amounts of radioactive materials both to the atmosphere and to two surface streams in the area, the Mohawk River at the Knolls Site and the Glowegee Creek at the West Milton Site. Prior to the release of this low level radioactivity to the environment, all KAPL liquid waste and exhaust air systems are carefully and continuously monitored. In addition to the in-plant control-monitoring, an environmental monitoring program is conducted both on and off-site at KAPL for the following purposes: (1) to audit the operational control of radioactive waste release to the environment and (2) to ascertain compliance with the standards established by the United States Atomic Energy Commission based on recommendations of the National Committee on Radiation Protection and Measurements (NCRP).

It has been the policy of the staff of the Knolls Atomic Power Laboratory to communicate with the Mohawk River Advisory Committee (MRAC) concerning KAPL operations as they affect waste disposal practices. The members of the MRAC are representatives of the New York State Health Department, the New York State Water Pollution Control Board and a sanitary engineering consultant.

KAPL environmental monitoring locations are given in the attached figure. A brief description of the types of samples collected at the various location is given in the referenced legend.

Liquid Radioactive Waste Disposal

West Milton Site

Because the Glowegee Creek does not have a reliable dilution potential, the radioactivity levels in the liquid waste from the West Milton Site are operationally controlled and diluted prior to release to the creek. Samples of Glowegee Creek water are taken once a week at two locations, 150 feet above and 2,640 feet below the point where the West Milton Site effluent enters the creek. The amounts of gross beta radioactivity discharged from the West Milton Site as well as the results of the river sampling are presented in table 1. Alpha analyses are not performed since no alpha radioactivity is discharged from the West Milton Site.

TABLE 1.—GROSS BETA RADIOACTIVITY DISCHARGED AND DETECTED IN THE GLOWEGEE CREEK

Quarter	Total waste discharged mc	Average concentration discharged μμc/liter	Average concentration in creek		Precipitation results μμc/liter
			Upstream μμc/liter	Downstream μμc/liter	
1959:					
First	4.8	1,500	46	42	2,170
Second	11.5	150	20	23	1,470
Third	23.2	200	23	31	310
Fourth	1.4	17	19	20	100
1960:					
First	0.6	28	28	18	159

The data in the table above corroborate the statement that the West Milton Site effluent did not adversely affect the levels of radioactivity detected in the Glowegee Creek. In addition, precipitation results have a variable effect upon the Glowegee Creek samples dependent upon the amount of rainfall, creek flow and the period of sampling relative to the period of precipitation.

Knolls Site

Based on hydraulic, hydrological and tracer studies of the Mohawk River basin by the United States Geological Survey in 1955, a decision was made by the AEC with the concurrence of MRAC to utilize in a limited degree the dilution potential of the Mohawk River for the disposal of low level radioactive liquid waste from the Knolls Site. All potential sources of liquid radioactive waste are connected to the collection tanks in the radioactive waste processing building. The release of liquid waste to the Mohawk River is regulated through the control and monitoring of concentrations of fission products in the collection tanks and control of the discharge rate of the effluent. Radioactive wastes with concentrations greater than 1.5×10^{7} μμc/liter are not discharged to the river. For wastes with less activity, it has been determined that in-plant and river dilution will bring the concentration of all radioisotopes present to less than 1/10 the permissible concentrations for continuous exposure as specified by the NCRPM in NBS Handbook 69. A continuous, proportional sample of the Knolls Site combined sewer effluent is taken at the point of discharge to the Mohawk River. Analyses of weekly composite samples are made for radiochemical content and these analyses show that strontium-90 is the principal component which has to be considered in the waste control program. The radioactivity content of the Knolls Site waste effluent is given in table 2.

TABLE 2.—RADIOACTIVITY CONTENT OF THE KNOLLS SITE WASTE EFFLUENT

Radioisotope	Calendar year 1959		First quarter 1960	
	Percent abundance	Average concentration μμc/liter	Percent abundance	Average concentration μμc/liter
Ce^{144}, Pr^{144}	37.8	15,000	24.9	6,000
Sr^{89}	18.0	7,400	23.4	5,600
Sr^{90}	19.1	7,800	10.3	2,500
I^{131}	-	-	1.8	430
Ru^{106}	1.6	660	1.0	240
Cs^{137}	17.3	7,100	30.2	7,200
Zr^{95}, Nb^{95}	1.3	530	2.0	480
Total	95.1	-	93.6	-

Mohawk River water is sampled at locations upstream and downstream from the Knolls Site. The sampling locations are: (1) at the General Electric Company Powerhouse eight miles upstream from the Knolls Site (a continuous sample after May 1959), (2) at the point of discharge to the Mohawk River from the Knolls Site (a continuous sample), (3) at the Vischer Ferry Powerhouse approximately two miles downstream (a continuous sample) and (4) at the City of Cohoes Pumping Station approximately thirteen miles downstream (weekly grab sample). The following table shows the amounts of radioactivity discharged from the Knolls Site as well as the results of the Mohawk River water and precipitation sampling.

TABLE 3.—GROSS BETA RADIOACTIVITY DISCHARGED AND DETECTED IN THE MOHAWK RIVER*

(Average concentrations in $\mu\mu$c/liter)

Quarter	Total waste discharged (millicuries)	Average concentration discharged	Upstream	Downstream			Precipitation
			GE powerhouse	Vischer Ferry	Cohoes**		
					Raw	Treated	
1959:							
First	4,459	130,000	(***)	36	44	26	950
Second........	294	11,000	3	20	20	12	920
Third.........	687	8,900	15	7	5	9	90
Fourth........	2,530	19,000	6	4	18	9	190
1960:							
First..........	2,295	24,000	6	4	11	5	65

*Knolls Site effluent is monitored continuously for alpha radioactivity; data are not reported for brevity. The average annual discharge rate was less than 1 percent of the most restrictive environmental limit for alpha (Pu 329).

**Cohoes samples are once a week grab samples, therefore they are less representative than the samples collected upstream.

***Prior to sampling.

Environmental Airborne Radioactivity

Air-cleaning equipment is an essential element of exhaust systems servicing areas capable of generating airborne radioactive wastes. At KAPL there are twelve exhaust systems which require air-cleaning equipment. These ventilation systems are non-recirculating; ten of which contain a glass wool prefilter and a Cambridge or CWS absolute filter. The air-cleaning system for the special materials machine shop uses a high velocity air supply connected to a cyclone separator unit with a glass wool filter. Another method of air cleaning at KAPL is the activated charcoal system used in the Radioactive Materials Laboratory. Air is exhausted through a glass prefilter and a high efficiency absolute filter prior to passing through the activated charcoal filters. In all cases the exhaust stacks are monitored continuously for radioactive materials to assure proper functioning of air cleaning systems.

Environmental airborne radioactivity is measured at three locations on the Knolls Site, five locations on the West Milton Site and at the General Electric Company Research Laboratory, approximately one mile west of KAPL-Knolls Site. Airborne radioactivity is sampled continuously and analyzed on a weekly basis. Each environmental monitoring station is equipped with film dosimeters to detect integrated gamma radioactivity levels. The averaged results of the airborne radioactivity analyses are given in the following table.

161<

TABLE 4.–GROSS BETA AIRBORNE RADIOACTIVITY *

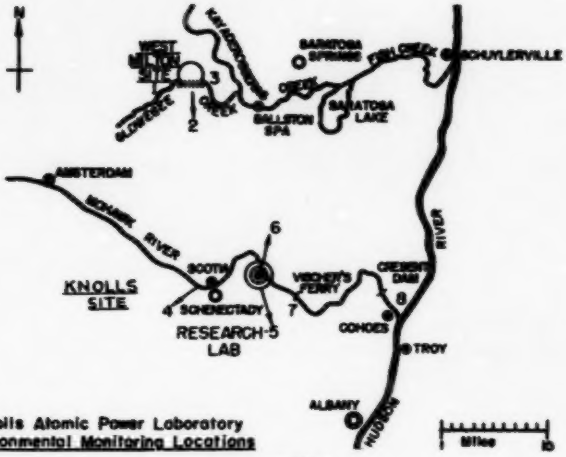
(Average concentrations in uuc/m^3)

Quarter	Knolls Site	West Milton	Off-Site
1959:			
First..........	1.36	1.73	1.55
Second........	1.52	2.45	2.10
Third.........	1.21	.30	.73
Fourth........	.44	.39	.81
1960:			
First..........	0.21	0.19	0.26

* Measurements of airborne radioactivity are made at least 48 hours after collection to allow naturally occurring short half-life radioactive material to decay.

Conclusions

As a result of the environmental monitoring program conducted by the Knolls Atomic Power Laboratory at both the Knolls Site and the West Milton Site, it is concluded that the operations at these installations did not adversely affect the radioactivity levels of the local environment.


N
WEST MILTON SITE
3
2
GLOWEGEE CREEK
KAYADEROSSERAS
SARATOGA SPRINGS
FISH CREEK
SCHUYLERVILLE
BALLSTON SPA
SARATOGA LAKE
AMSTERDAM
MOHAWK RIVER
6
SCOTIA
KNOLLS SITE
4
SCHENECTADY
RESEARCH LAB
5
VISCHER'S FERRY
7
CRESCENT DAM
8
COHOES
TROY
RIVER
ALBANY
HUDSON
Miles
10

Knolls Atomic Power Laboratory
Environmental Monitoring Locations

FIGURE 1

1. Glowegee Creek sampling station 150 feet upstream from the entrance of the West Milton Site effluent. Samples of Glowegee Creek water are collected weekly during the warmer seasons.
2. West Milton Site–Environmental radiation levels and particulate airborne radiation levels are sampled continuously at five geographically placed locations on the Site. Precipitation is sampled continuously.
3. Glowegee Creek sampling station 2,640 feet downstream from the West Milton Site. Samples of Glowegee Creek water are collected weekly.
4. General Electric Powerhouse, about eight miles upstream from the Knolls Site; Mohawk River water is sampled continuously.
5. General Electric Laboratory, 4,000 feet west of the Knolls Site, has a continuously operating radiation-level detector and air monitor for particulate airborne materials.
6. Knolls Site environmental particulate air and radiation levels are sampled continuously at three stations at different geographic locations. In addition, precipitation, continuous and proportional samples of combined sewer effluent are collected. Samples of soil and vegetation are collected periodically.
7. Mohawk River water is sampled continuously at the Vischer Ferry Powerhouse which is approximately two miles downstream from the Knolls Site.
8. Cohoes is approximately thirteen miles downstream from the Knolls Site. Samples of untreated Mohawk River water and the Cohoes drinking water are collected weekly.

496

NATIONAL REACTOR TESTING STATION

Health and Safety Division, Idaho Operations Office
Atomic Energy Commission
Idaho Falls, Idaho

Issued July 1960

The remoteness of National Reactor Testing Station facilities practically eliminates the possibility of any significant direct radiation exposures to the neighboring population. However, trace amounts, well below the maximum permissible limits for the various isotopes,[1] are dispersed into the natural environment. Both liquid and gaseous wastes containing a very low level of radioactivity are disposed of daily at the National Reactor Testing Station.

The Health and Safety Division collects and analyzes a large number of water, air, milk, and rabbit bone samples as part of their constant monitoring program. The attached table presents the data collected for 1959 and the first quarter of 1960.

In many cases it can be seen that the data have to be presented as being less than a certain value. This is very important in that many times it is not economically feasible or practical to develop analytical procedures beyond their ability to determine adequately that the amount being analyzed is insignificant. The value stated in these cases represents the present detection limit for that particular measurement.

An example of NRTS interpretation of environmental water values follows:

> "The activity is measured at equal to or less than 150 micromicrocuries of beta activity per liter of water (analytical detection limit). Knowing that strontium-90 will contribute less than 25 percent of any total fission product activity if detected, the 150 $\mu\mu$c/liter detection limit assures us that any strontium-90 contribution would be less than 45 micromicrocuries per liter, or well below the maximum permissible concentration for this isotope. Further efforts to quantize the activity contribution from natural radioactive elements (i.e., uranium and thorium) have not been necessary since our detection limit is sufficiently low to allow adequate evaluation of the radioactivity in potable water supplies."

The monitoring of the environs for airborne radioactivity has been qualitative with a back-up capability of activating additional samplers by radio signal to collect quantitative data. Although the back-up stations have been activated on occasion when on-site releases were known to have occurred, no significant values were recorded.

Rabbit bones are sampled and analyzed as an evaluation of the up-take and concentration strontium-90 in a biological system. Since the jack rabbit lives completely on the open environment as opposed to man who eats washed and prepared food and since his metabolic function may be entirely different, the amount of strontium-90 concentrated in the bones is ten to twenty times higher than that found in human bones. The amount of strontium-90 found in control rabbits taken from an area under minimum influence of any activity originating on the National Reactor Testing Station is seen to be very near that of rabbits on the perimeter of the site and predominantly down wind from the National Reactor Testing Station facilities. The amount of strontium-90 detected in all off-site samples to date is due to fallout from past weapons tests in locations remote from the NRTS.

Iodine-131 being a gaseous fission product and highly mobile lends itself to being a most sensitive indicator for environmental monitoring. Milk samples from environmental cows are routinely analyzed for the presence of this isotope. Again, the values in table I are lower than the detection limit which is suitable for detecting any biologically significant amount of I^{131} in the sample.

The off-site monitoring film data for 1959 consists of intermittent testing in preparation for a continuous program which has been put into effect to provide data starting the second quarter of 1960. Two high values were recorded, but since a duplicate film at the same location read less than 20 mrem, these were concluded to be invalid since both films should agree within the limits of experimental error if the exposure had been real.

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[1] National Bureau of Standards Handbooks 59 and 69.

TABLE 1.—ENVIRONMENTAL MONITORING DATA

Sample	Number of stations	Approximate frequency	Calendar year 1959			First quarter 1960		
			Number of samples	Alpha	Beta	Number of samples	Alpha	Beta
Off-site ground water	27	Bimonthly	110	<3 μμc/liter	<150 μμc/liter	39	<3 μμc/liter	<150 μμc/liter
On-site production well water	16	Weekly	607	<3 μμc/liter	300 μμc/liter	162	3.1 μμc/liter	<150 μμc/liter
Off-site air	20	Biweekly		(**)		(**)	(**)	
Perimeter rabbit bones (Jack Rabbit)	5	Quarterly	10	20 μμc/gm Ca*		10	20.1 μμc/gm Ca*	
Off-site control rabbit bones (Jack Rabbit)	1	Monthly	17	17 μμc/gm Ca*		4	20.3 μμc/gm Ca*	
Off-site milk (I^{131})	24	Monthly	237	γ <1000 μμc/liter		70	γ <1000 μμc/liter	
Off-site monitoring badges	19	Intermittent	76	β <20 mrem/90 days γ <20 mrem/90 days		19	β <20 mrem/90 days γ <20 mrem/90 days	

*Analyses for Sr^{90} in rabbit bones will lag by one calendar quarter. This data is for the 4th Quarter 1959.

**Qualitative only.

164<

OAK RIDGE NATIONAL LABORATORY

Union Carbide Nuclear Company
Oak Ridge, Tennessee

Issued May 1960

Radioactive waste materials arising from the operation of atomic energy installations at the Oak Ridge National Laboratory are collected, treated and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to earthen pits located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

Air that may have become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by filters, scrubbers and/or precipitation.

Air Monitoring

Atmospheric contamination and fall-out occurring in the general environment of east Tennessee are monitored by two systems of monitoring stations. One system consists of seven stations which encircle the plant areas (fig. 1) and provides data for evaluating the impact of all Oak Ridge operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 120 miles (fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Table 1 presents the data from the air monitoring program for 1959 and the first quarter of 1960.

TABLE 1.—CONTINUOUS AIR MONITORING FILTER DATA

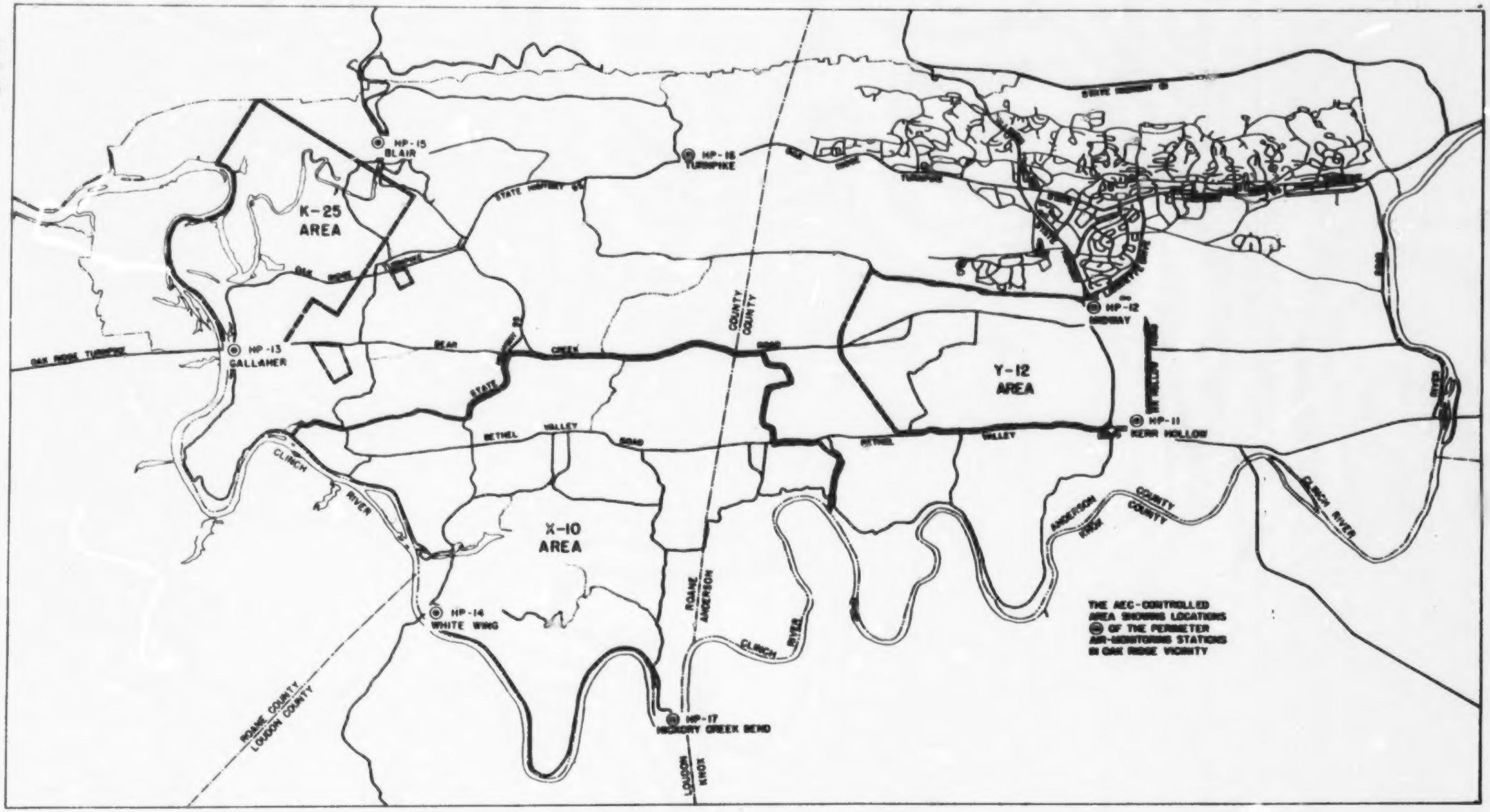
(Average concentrations in $\mu\mu c/m^3$)

Station number	Calendar year 1959		First quarter 1960	
	Number of samples	Gross activity	Number of samples	Gross activity
Perimeter stations:				
HP-11	52	1.577	13	0.113
HP-12	49	1.629	13	.098
HP-13	52	1.663	13	.106
HP-14	52	1.1130	13	.090
HP-15	52	1.997	13	.131
HP-16	52	1.348	13	.099
HP-17	52	1.686	13	.121
Remote stations:				
HP-19.	52	2.373	13	.124
HP-20	52	2.211	13	.117
HP-21	37	1.091	13	.107
HP-22	39	1.601	13	.132
HP-23*	29	0.513	13	.125
HP-24*	26	.253	13	.119
HP-25	46	1.804	13	.109
HP-26	52	1.377	13	.080

*Stations in operation only during latter half 1959.

499

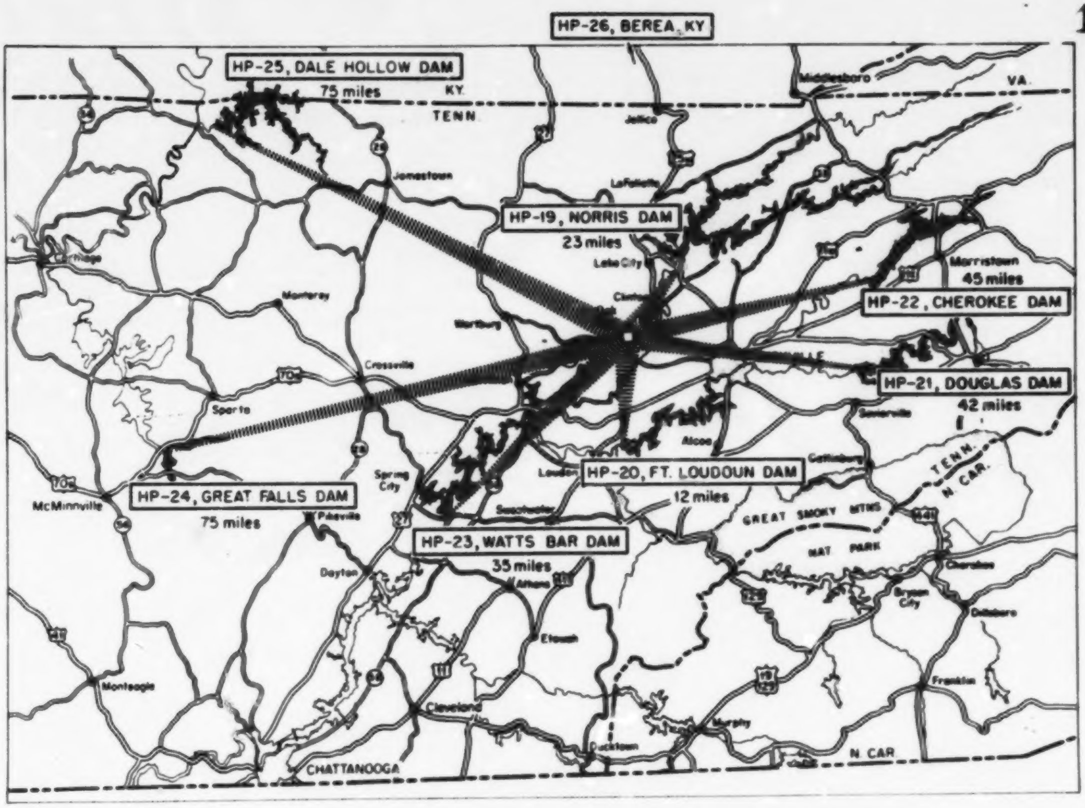
165<


HP-15
BLAIR
HP-16
TURNPIKE
STATE HIGHWAY 61
K-25
AREA
OAK RIDGE TURNPIKE
HP-13
GALLAHER
BEAR
CREEK
ROAD
STATE
COUNTY
COUNTY
HP-12
HP-11
KERR HOLLOW
Y-12
AREA
BETHEL
VALLEY
ROAD
CLINCH
RIVER
X-10
AREA
HP-14
WHITE WING
ROANE COUNTY
LOUDON COUNTY
ROANE
ANDERSON
CLINCH
RIVER
HP-17
HICKORY CREEK BEND
LOUDON
KNOX
ANDERSON
KNOX
COUNTY
COUNTY
CLINCH RIVER
THE AEC-CONTROLLED
AREA SHOWING LOCATIONS
OF THE PERIMETER
AIR-MONITORING STATIONS
IN OAK RIDGE VICINITY

PERIMETER AIR MONITORING STATIONS

FIGURE 1

500


HP-26, BEREA, KY
HP-25, DALE HOLLOW DAM
75 miles
KY.
TENN.
VA.
Middlesboro
Jellico
Jamestown
LaFollette
HP-19, NORRIS DAM
23 miles
Lake City
Morristown
45 miles
HP-22, CHEROKEE DAM
Monterey
Wartburg
Crossville
HP-21, DOUGLAS DAM
42 miles
Sevierville
Sparta
Alcoa
Gatlinburg
TENN.
N. CAR.
Spring City
Loudon
HP-20, FT. LOUDOUN DAM
12 miles
McMinnville
HP-24, GREAT FALLS DAM
75 miles
Pikeville
Sweetwater
GREAT SMOKY MTNS
NAT. PARK
HP-23, WATTS BAR DAM
35 miles
Dayton
Athens
Cherokee
Bryson City
Dillsboro
Etowah
Monteagle
Cleveland
Franklin
Murphy
Ducktown
CHATTANOOGA
N. CAR.

STATION SITES FOR REMOTE AIR MONITORING SYSTEM

FIGURE 2

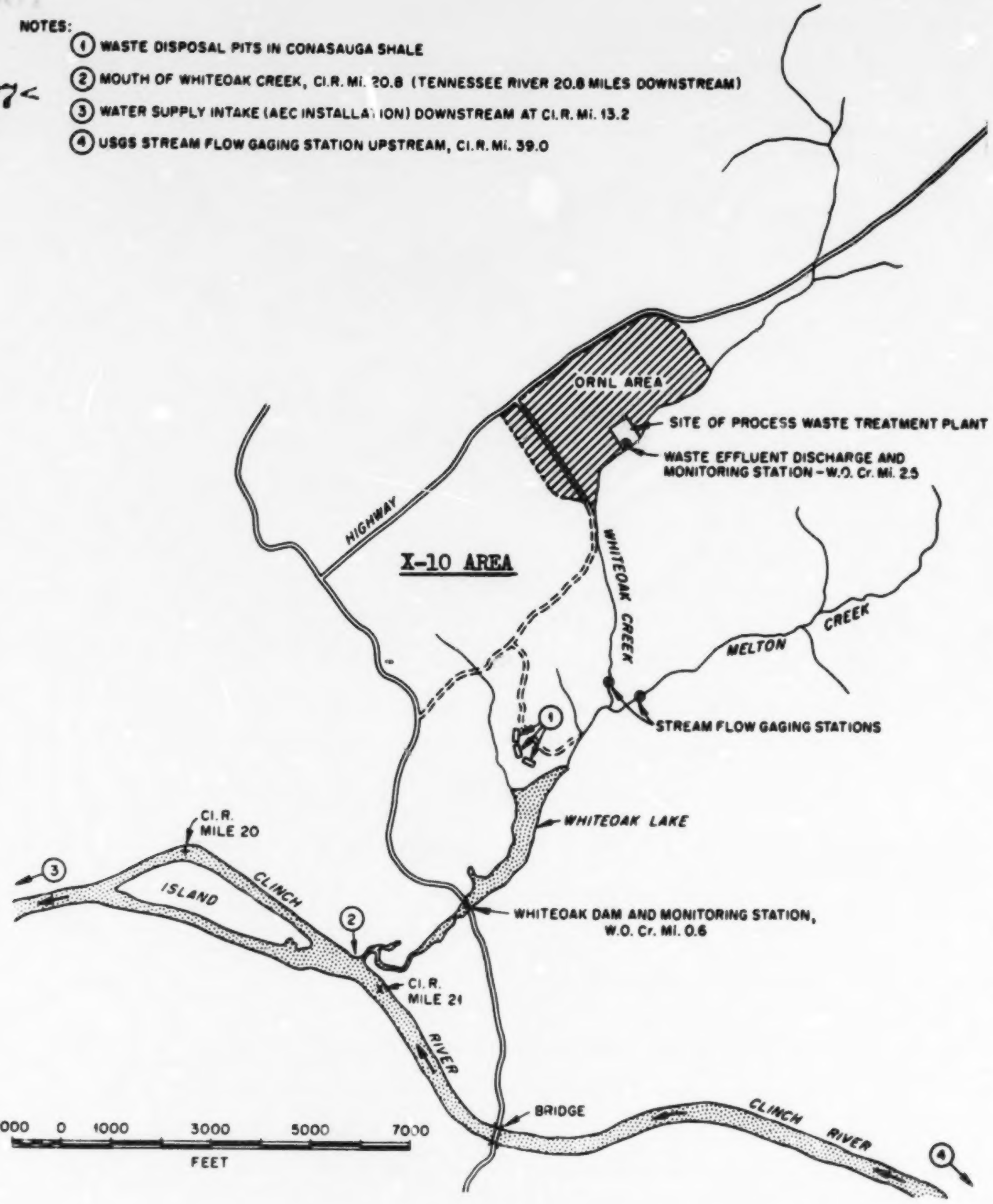
Air contamination levels during the first half of 1959 were a factor of 4 to 6 times greater than the average for the entire year. By the end of 1959, air contamination levels had decreased to approximately 1/5 the value given for the yearly average. Specific analysis for fission products and decay studies indicated that the high levels experienced during the first part of the year were due to the world-wide fall-out from weapons testing. The low values for remote stations 23 and 24 resulted from the fact that these stations were in operation only during the latter half of 1959 and do not reflect the higher fall-out levels experienced during the first half of the year.

Water Monitoring

Large volumes of low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and then to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population in the neighborhood of a controlled area as recommended by the National Committee on Radiation Protection (NCRP). The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in figs. 3 and 4. Samples are taken in Poplar Creek and White Oak Creek and at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously by the United States Geological Survey to obtain dilution factors for calculating the probable concentrations of wastes in the river. Water monitoring data is tabulated in tables 2 and 3.

167<



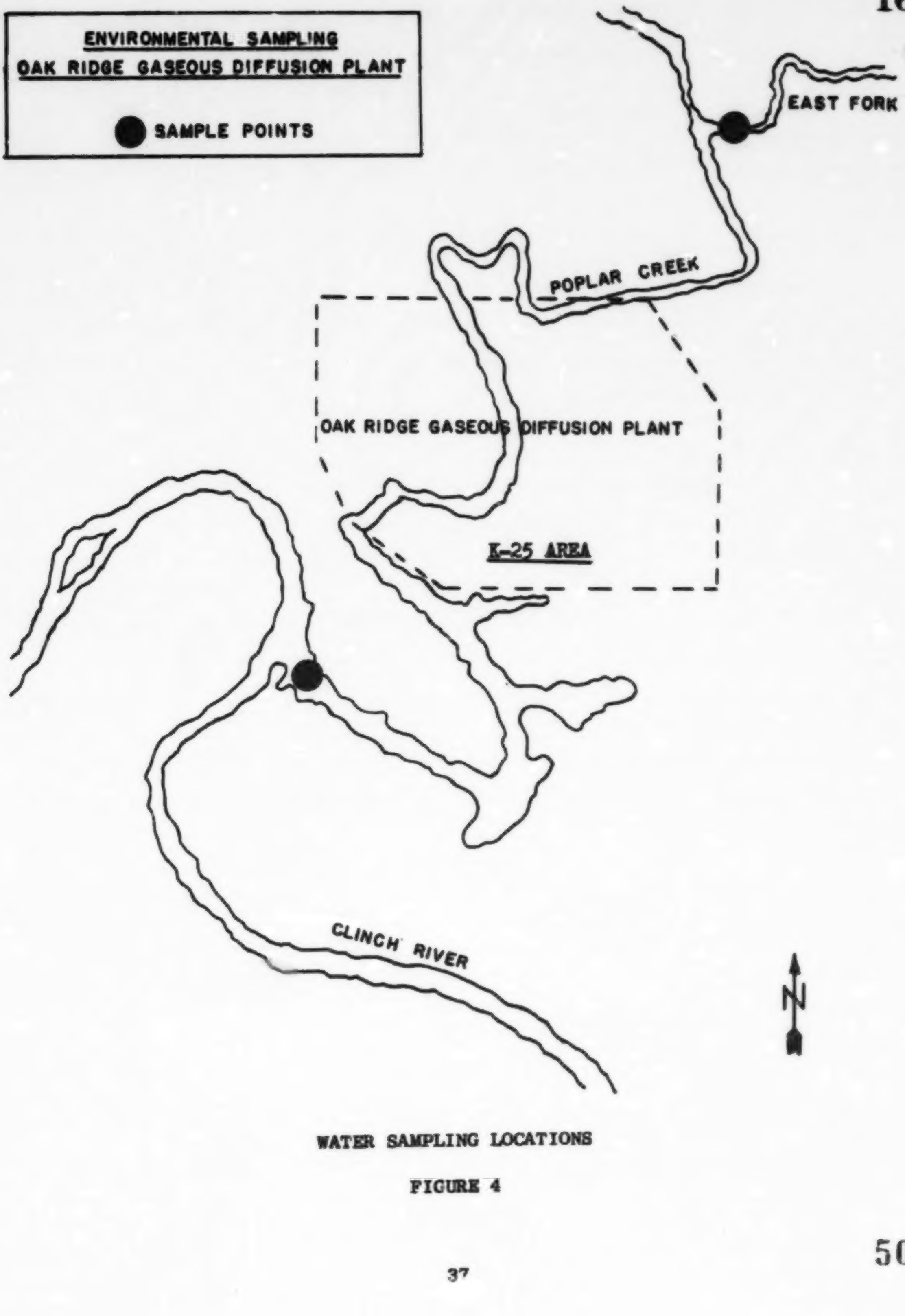
NOTES:
① WASTE DISPOSAL PITS IN CONASAUGA SHALE
② MOUTH OF WHITEOAK CREEK, Cl.R. Mi. 20.8 (TENNESSEE RIVER 20.8 MILES DOWNSTREAM)
③ WATER SUPPLY INTAKE (AEC INSTALLATION) DOWNSTREAM AT Cl.R. Mi. 13.2
④ USGS STREAM FLOW GAGING STATION UPSTREAM, Cl.R. Mi. 39.0

ORNL AREA
SITE OF PROCESS WASTE TREATMENT PLANT
WASTE EFFLUENT DISCHARGE AND MONITORING STATION - W.O. Cr. Mi. 2.5
HIGHWAY
X-10 AREA
WHITEOAK CREEK
MELTON CREEK
STREAM FLOW GAGING STATIONS
①
WHITEOAK LAKE
Cl.R. MILE 20
③
ISLAND
CLINCH
②
WHITEOAK DAM AND MONITORING STATION, W.O. Cr. Mi. 0.6
Cl.R. MILE 21
RIVER
BRIDGE
CLINCH RIVER
④
1000 0 1000 3000 5000 7000
FEET

ORNL LOCATION MAP

FIGURE 3

502


ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT
● SAMPLE POINTS
EAST FORK
POPLAR CREEK
OAK RIDGE GASEOUS DIFFUSION PLANT
K-25 AREA
CLINCH RIVER
N

WATER SAMPLING LOCATIONS

FIGURE 4

169<

TABLE 2.—MAJOR RADIOACTIVE ELEMENTS IN THE CLINCH RIVER

(Average concentrations in $\mu\mu$c/liter)

Location	Sampling period	Sr^{90}	Ce^{144}	Cs^{137}	Ru$^{103-106}$	Co^{60}	Total
Upstream (mi. 37.5)	10/1/59-1/29/60	1.1	1.0	(*)	(*)	(*)	4.5
	-	-	-	-	-	-	-
Pt. of Entry (mi. 20.8)**	12/28/58-12/27/59	20.0	15.0	19.0	74	18	310
	12/28/59-3/27/60	6.7	16.2	14.8	447.5	34.5	1032
Downstream (mi. 4.5)	10/23/58-11/3/59	18.6	5.4	5.3	11.4	2.3	49
	11/4/59-1/27/60	9.1	3.6	4.1	696.8	8.6	775

*None detected.

**Values given for [illegible] location are calculated values based on the levels of waste released and the dilution afforded by the river.

TABLE 3.—CONCENTRATION OF RADIOACTIVITY IN POPLAR CREEK

(Average concentrations in $\mu\mu$c/liter)

Location	Calendar year 1959			First quarter 1960		
	Number of samples	Uranium	Gross beta	Number of samples	Uranium	Gross beta
Upstream (East Fork)	52	62	180	13	44	356
Downstream (Outfall)	52	6	220	13	5	747

Normal Sampling Frequency: Continuous sampling composited over one week.

Table 4 presents the results of the radioactivity in rain water sampling.

504

TABLE 4.—RADIOACTIVITY IN RAIN WATER

(Average concentrations in $\mu\mu$c/liter)

Station number	Calendar year 1959		First quarter 1960	
	Number of samples	Gross activity	Number of samples	Gross activity
Perimeter station:				
HP-11	44	722	11	54
HP-12	44	630	11	56
HP-13	44	610	11	44
HP-14	43	653	11	30
HP-15	39	578	11	43
HP-16	44	882	11	53
HP-17	43	814	11	48
Remote stations:				
HP-19	45	1126	11	71
HP-20	49	1465	11	53
HP-21	31	386	11	60
HP-22	33	441	11	46
HP-23*	23	132	11	58
HP-24*	21	141	11	83
HP-25	41	802	12	52
HP-26	44	1014	12	99

*Stations in operation only during latter half of 1959.

External Gamma Activity

External gamma radiation levels are measured monthly at five locations in the Oak Ridge area. Measurements are taken with a GM survey instrument at a distance of three feet above ground. The results are tabulated in table 5.

TABLE 5.—EXTERNAL GAMMA RADIATION LEVELS

(Average levels in mr/hr)

Period	Location				
	Solway Gate	Y-12 East Portal	Newcomb Road Oak Ridge	Gallaher Gate	White Wing Gate
Calendar year 1959	0.024	0.019	0.021	0.027	0.027
First quarter 1960	.017	.015	.014	.022	.017

External gamma radiation levels in the Oak Ridge area do not differ significantly from the average of the levels measured throughout the United States by the Public Health Radiation Surveillance Network.

PADUCAH GASEOUS DIFFUSION PLANT

Union Carbide Nuclear Company
Paducah, Kentucky

Issued July 1960

Waste disposal operations at the Paducah Gaseous Diffusion Plant, operated by the Union Carbide Nuclear Company, are concerned exclusively with uranium. The problem does not involve highly radi-

oactive waste materials such as those associated with reactor operations. Most of the waste at this plant originates from the cleaning of process equipment. In addition to this, small quantities escape to
171< the atmosphere in the form of uranium hexafluoride.

Figure 1 is a map of the Paducah Plant and the immediate vicinity showing the tributaries to the Ohio River which receive the liquid effluents from the plant, and the locations where monitoring of the drainage water is performed. The solids waste pit and cylinder storage yard for uranium hexafluoride are also shown.

The environmental monitoring program consists of a continuing system for sampling the air at four stations around the plant perimeter fence, the water at two locations in the Big Bayou Creek, one in Little Bayou Creek and four in the Ohio River. The results of this monitoring are presented in tables 1 and 2.

TABLE 1.—GROSS STREAM WATER ACTIVITY

Location	Type of analysis	Calendar year 1959			First quarter 1960		
		Number of samples	Average uuc/liter	Percent MPC*	Number of samples	Average uuc/liter	Percent MPC*
Big Bayou leaving Gov't. Land	Uranium Gross Beta	55	47.3 392	0.24 2.0	12	36.3 1,476	0.18 7.38
Big Bayou at Ogden Bridge Road	Uranium Gross Beta	12	15.8 377	0.08 1.9	3	7.4 415	0.04 2.08
Little Bayou	Uranium Gross Beta	53	281 9,120	1.4 46	12	307 13,470	1.54 67.8
Ohio River above Paducah Plant	Uranium Gross Beta	19	2 101	< 0.01 0.51	4	< 2 130	< 0.01 0.65
Ohio River—South Side at Joppa	Uranium Gross Beta	15	2 161	< 0.01 0.81	4	< 2 157	< 0.01 0.78
Ohio River—Middle at Joppa	Uranium Gross Beta	15	2 369	< 0.01 1.8	4	< 2 147	< 0.01 0.74
Ohio River—below Paducah Plant	Uranium Gross Beta	12	6.1 119	0.03 0.6	4	< 2 176	< 0.01 0.88

*The values for MPC in water are 1/10 of the MPC allowed for continuous occupational exposure as given in Handbook 69, National Bureau of Standards, issued June 5, 1959.

TABLE 2.—GROSS AIR ACTIVITY

Year	Number of samples	Type of analysis	Average of 4 sampling points $\mu\mu c/m^3$	Percent MPC*
1959......................	102 85	Gross Alpha Gross Beta	0.311 2.07	16 0.21
1960—First quarter..	32 32	Gross Alpha Gross Beta	0.15 1.9	7 0.2

*The values for MPC in air are 1/10 of the MPC allowed for continuous occupational exposure as given in Handbook 69, National Bureau of Standards, issued June 5, 1959.

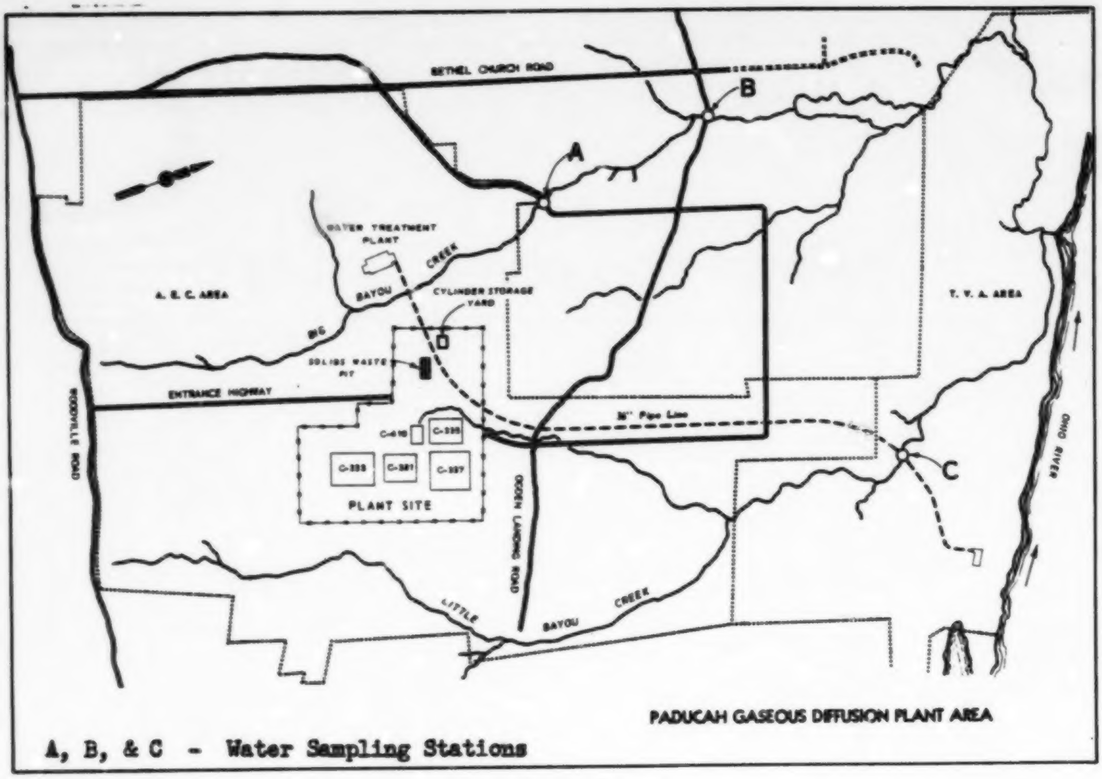

BETHEL CHURCH ROAD
B
A
WATER TREATMENT PLANT
A. E. C. AREA
BIG BAYOU CREEK
CYLINDER STORAGE YARD
D
SOLIDS WASTE PIT
ENTRANCE HIGHWAY
WOODVILLE ROAD
36" Pipe Line
C-610
C-335
C-333
C-331
C-337
PLANT SITE
OGDEN LANDING ROAD
C
T. V. A. AREA
OHIO RIVER
LITTLE BAYOU CREEK
PADUCAH GASEOUS DIFFUSION PLANT AREA
A, B, & C - Water Sampling Stations

FIGURE 1

SAVANNAH RIVER PLANT

E. I. du Pont de Nemours Company
Aiken, South Carolina

Issued July 1960

The Savannah River Plant maintains a continuous monitoring program to determine the concentrations of radioactive materials in a 1,200 square-mile area outside the Plant perimeter. Included are parts of Aiken, Barnwell and Allendale Counties, South Carolina, and Richmond, Burke and Screven Counties, Georgia. This program, initiated in 1951, prior to start-up of Plant operations, is carried out by the Health Physics Section of the du Pont Company, prime contractor for operation of the plant for the Atomic Energy Commission.

The concentrations of radioactive materials found during 1959 and the first quarter of 1960 in the environs of the Savannah River Plant through release of radioactive wastes by the Plant were so small that in most cases they could not be definitely distinguished from that due to natural background radiation or to debris from past weapons tests.

Atmospheric Monitoring

Air and rainwater samples are collected continuously at thirteen monitoring stations which are spaced around the Plant in two concentric circles such that a significant Plant release of radioactivity to the air would be detected regardless of prevailing wind conditions (see figure [illegible]). Five monitoring stations are located on the inner circle which follows, within a few miles, the Plant boundary (Plant Perimeter locations). The outer circle circumscribes an area extending approximately 25 miles from the center of the Plant and has eight monitoring stations (25 mile radius locations). The basic purpose of the two concentric routes is to determine whether the Plant has contributed radioactivity to the atmosphere. An average radioactivity level at the Plant Perimeter, which is substantially higher than that observed at the 25 Mile Radius, would be indicative of a Plant contribution. Small differences in average radioactivity levels, however, are attributed to both the non-uniformity of fallout and to statistical variation of the analyses. The average concentrations, which show plant contributions to be negligible, are shown in table 1. 173<

SAMPLE COLLECTION ROUTES

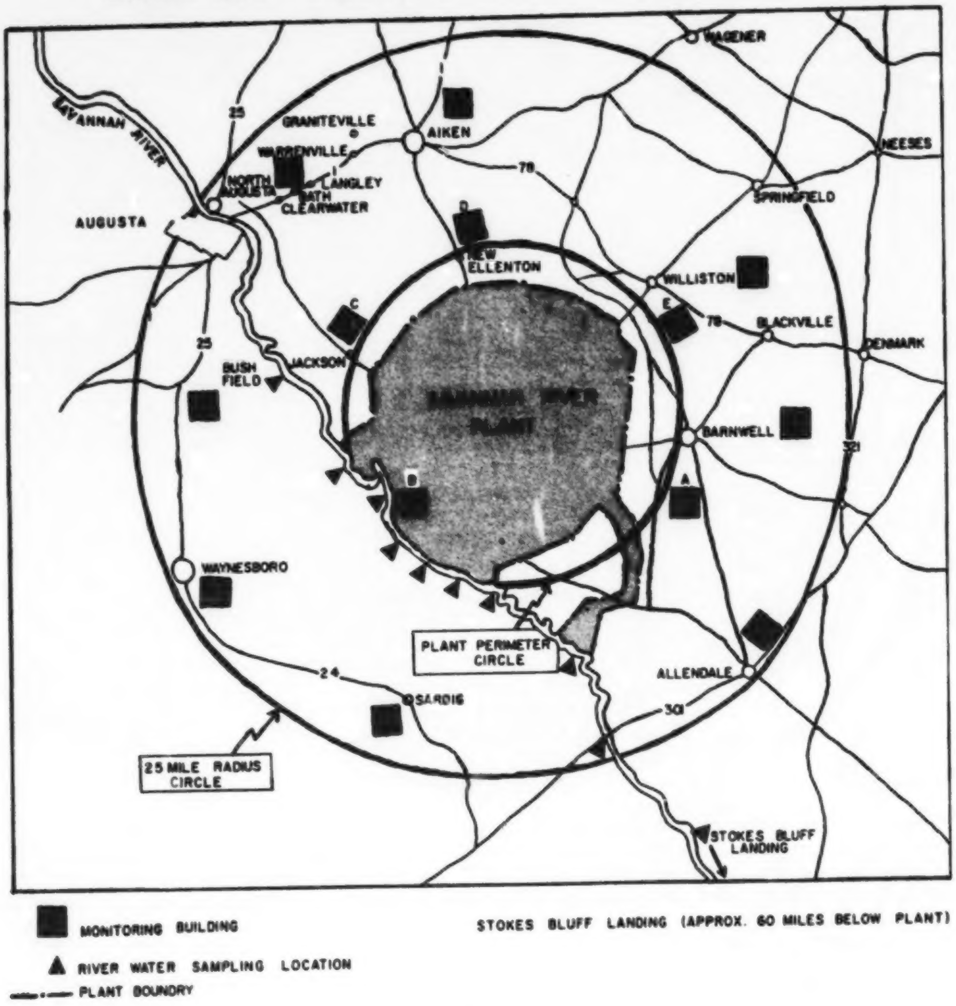

WAGENER
SAVANNAH RIVER
25
GRANITEVILLE
AIKEN
WARRENVILLE
NORTH AUGUSTA
LANGLEY
BATH
CLEARWATER
78
NEESES
SPRINGFIELD
AUGUSTA
D
NEW ELLENTON
WILLISTON
C
E
78
BLACKVILLE
DENMARK
25
BUSH FIELD
JACKSON
SAVANNAH RIVER PLANT
BARNWELL
321
B
A
WAYNESBORO
PLANT PERIMETER CIRCLE
ALLENDALE
24
SARDIS
301
25 MILE RADIUS CIRCLE
STOKES BLUFF LANDING
MONITORING BUILDING
STOKES BLUFF LANDING (APPROX. 60 MILES BELOW PLANT)
RIVER WATER SAMPLING LOCATION
PLANT BOUNDRY

FIGURE 1

TABLE 1.—GROSS RADIOACTIVITY IN AIR

(Average concentrations in $\mu\mu c/m^3$)

Location	Calendar year 1959			First quarter 1960		
	Alpha	Nonvolatile Beta	Radio-iodine	Alpha	Nonvolatile Beta	Radio-iodine
Plant Perimeter	0.001	3.8	0.09	0.0012	0.17	0.04
25 Mile Radius	0.001	3.0	0.05	0.0009	0.12	0.04

TABLE 2.—GROSS RADIOACTIVITY IN RAINWATER

(Average concentrations in $\mu\mu c$/liter)

Location	Calendar year 1959			First quarter 1960		
	Alpha	Nonvolatile Beta	Radio-iodine	Alpha	Nonvolatile Beta	Radio-iodine
Plant Perimeter	0.6	230	19	0.6	86	32
25 Mile Radius	0.5	310	16	0.5	106	31

Water Monitoring

The communities in the vicinity of the Savannah River Plant obtain their sanitary water from deep wells or small surface streams. The results from the water samples collected monthly in fourteen surrounding towns are essentially the same as those observed prior to the startup of the Savannah River Plant in 1951. The average concentrations measured during the quarter are presented in table 3.

TABLE 3.—RADIOACTIVITY IN PUBLIC WATER SAMPLES

(Average concentrations in $\mu\mu c$/liter)

Period	Alpha	Nonvolatile Beta
Calendar years 1951-52	1.2	6
Calendar year 1959	0.9	9
First quarter 1960	0.7	7

Approximately 120 miles downstream from the plant, the city of Savannah processes water from Abercorn Creek for industrial and sanitary consumption. This creek is largely Savannah River water with some swamp drainage. Savannah is the only municipality that uses river water downstream from the plant. Radioactivity in the river adjacent to the Plant may be seen to be slightly higher than at other locations, but is hardly significant when compared to maximum permissible concentration levels. Greater than 85 percent of the radioactivity released to the river was neptunium-239 which has a 2.3 day half life. Downstream, the radioactivity decrease resulted from decay of short-lived radionuclides and the natural ion-exchange capacity of the river bed. The average concentrations observed at each of the three general sampling locations are listed in table 4.

TABLE 4.—RADIOACTIVITY IN SAVANNAH RIVER WATER

(Average concentrations in $\mu\mu$c/liter)

Location	Calendar year 1959				First quarter 1960			
	Alpha	Nonvolatile Beta	H^3	Sr^{90}	Alpha	Nonvolatile Beta	H^3	Sr^{90}
3 miles above above Plant	0.4	17	4,000	0.66	0.4	7	4,000	0.6
Plant Boundary	.4	36	-	-	0.9	32	-	-
10 miles below Plant	.4	21	11,000	1.27	0.4	18	6,000	1
60 miles below Plant	.4	23	8,000	-	0.4	13	5,000	-

Although a slight plant contribution is noted, the radioactive content is well below the maximum permissible concentration levels of the NCRP.

Vegetation and Food Monitoring

Radioactive materials which are air-borne may deposit on plants and soil. Those that deposit directly on food and forage plants contaminate them by remaining attached to the surfaces of the above-ground parts, or by absorption into leaves and stems. Radioactive material in soil may be absorbed through the root system and then enter the plant's metabolism. Vegetation (Bermuda grass) samples were collected weekly at 14 locations along the Plant perimeter and at 14 locations along the 25-mile radius route. The availability of Bermuda grass at most locations on the sampling routes and its importance as a pasture grass were the primary reasons for its choice as the sampling species. As indicated by the close correlation in table 5 between the radioactivity found in vegetation along the plant perimeter and that found on the 25-mile radius route, the radioactivity on the vegetation in the environs of the Savannah Plant is the result of weapons test fallout.

TABLE 5.—RADIOACTIVITY IN BERMUDA GRASS SAMPLES

(Average concentrations in $\mu\mu$c/gm*)

Location	Calendar year 1959			First quarter 1960		
	Alpha	Nonvolatile Beta	Radio-iodine	Alpha	Nonvolatile Beta	Radio-iodine
Plant Perimeter	0.13	140	1.0	0.22	46	1.5
25 Mile Radius	.16	190	.8	.27	38	1.3

*Dry weight.

An approximate two-fold increase in the concentration of nonvolatile beta emitters and radioiodine was observed during March, which appeared to be associated with weapons test debris.

Milk from dairies and farms in Aiken, North Augusta, Snelling, Talatha and Langley, South Carolina was analyzed weekly for radioiodine (principally iodine-131) and tritium content. The average radioiodine concentration in the 313 samples collected during 1959 and the first quarter of 1960 was less than the minimum sensitivity of the analysis which is equivalent to 25 percent of the NCRP maximum permissible concentration. The average tritium concentration was approximately 2 percent of the maximum permissible concentration.

The concentration of strontium-90 in milk produced locally is determined once per quarter. The average concentration detected in local milk samples during 1959 and the first quarter of 1960 was less than 50 percent of the maximum permissible concentration. This level is essentially the same as that detected in milk obtained from the Atlanta, Georgia milkshed[1] during 1959 (17.1 $\mu\mu$c/l) and is attributed entirely to the accumulation of strontium-90 fallout from previous nuclear weapons tests.

The determination of radioactivity concentrations in algae is important because they are well known concentrators of specific radioactive materials and because of their relationship in the food chain of aquatic organisms. Indigenous algae, primarily green ***(Vaucheria)*** and blue-green ***(Phormidium)***, were collected weekly upstream, adjacent to, and downstream from the Plant. The results are shown in table 6.

TABLE 6.–RADIOACTIVITY IN SAVANNAH RIVER ALGAE

(Average concentrations in $\mu\mu$c/gm*)

Location	Nonvolatile Beta Emitters	
	Calendar year 1959	First quarter 1960
3 miles above Plant	60	-
At Plant Boundary	110	48
10 miles below Plant	83	53
60 miles below Plant	60	-

*Dry weight.

Fish (predominantly bream and catfish, the edible species) were collected weekly above, adjacent to, below the Plant. The average nonvolatile beta concentrations measured in the edible portion (flesh) are given in table 7.

TABLE 7.–RADIOACTIVITY IN FISH FLESH

(Average concentrations in $\mu\mu$c/gm*)

Location	Nonvolatile Beta Emitters	
	Calendar year 1959	First quarter 1960
3 miles above Plant	5	4
At Plant boundary	5	5
10 miles below Plant	5	-
60 miles below Plant	5	3

* Wet weight.

General Conclusion

Monitoring of domestic water supplies, fish and milk in the vicinity of the plant has in no case shown levels of radiation that are of special significance from a health standpoint.

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[1] Monthly Reports, U. S. Department of Health, Education, and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

177<

SHIPPINGPORT ATOMIC POWER STATION

Duquesne Light Company
Beaver County, Pennsylvania

June 1, 1960

Environmental levels of radioactivity at the Shippingport Atomic Power Station for 1959 were reported in the July 1960 issue of Radiological Health Data. The following report presents a summary of the data for the first quarter of 1960.

The Shippingport Atomic Power Station is the first large scale nuclear power electric generating station and is operated for the Atomic Energy Commission by the Duquesne Light Company. During this quarter, the plant was undergoing refueling for the first time since operation began in December 1957. After more than 5,800 hours of full power operation, part of the reactor fuel required replacement. Because of refueling, the reactor was not operating during this period and the chief wastes produced were those from the laundry from washing protective clothing used by the workers, and decontamination operations on plant apparatus.

An environmental radiation survey of Shippingport and the surrounding area was initiated by the AEC in January of 1956 prior to operation of the plant. Since Shippingport began operation in December 1957, the survey has been continued as a check on the rigid plant controls and design features that insure that the amounts of radioactivity released are limited. The results of the environmental radiation survey have shown that the controls and design features have been completely adequate to minimize radioactivity released to the environment.

The liquid and gaseous discharges from Shippingport are controlled so that concentrations do not exceed those recommended by the National Committee on Radiation Protection (NCRP). The Duquesne Light Company as operator of the Shippingport Atomic Power Station has a permit from the State of Pennsylvania to discharge limited amounts of liquid wastes to the Ohio River. The limits imposed by the State are designed to insure that permissible concentrations recommended by the NCRP and Pennsylvania Regulation 433 will not be exceeded.

Liquid Wastes

The radioactive liquid wastes discharged during the first quarter of 1960 are summarized below. The average concentrations shown in the table are in addition to normal background radioactivity in the condenser cooling water used for dilution in the effluent channel. The condenser cooling water is river water that is pumped through the turbine-generator plant condenser.

TABLE 1.—SUMMARY OF GROSS RADIOACTIVITY RELEASED TO OHIO RIVER

Period	Total per month μc	Average per day μc	Average concentration in effluent channel during release $\mu\mu c$/liter
1960			
January	22,746	750	6.7
February	21,332	701	5.8
March	22,908	754	4.9

The maximum total discharge in one day during the quarter was 3,453 microcuries. No tritium was released during the quarter.

River water samples are taken continuously at four locations upstream and downstream from Shippingport and analyzed weekly. The upstream sampling stations are at the Phillips Power Station of the Duquesne Light Company (about 20 miles upstream) and at the cooling water intake at Shippingport. The downstream continuous sampling stations are on the water intake lines of the water treatment plants at Midland, Pennsylvania and East Liverpool, Ohio, approximately one and eight miles downstream respectively. In addition, grab samples are collected weekly from the Ohio River at U. S. Corps of Engineers Lock and Dam No. 7, about one mile downstream. Table 2 shows this data.

TABLE 2.–GROSS RADIOACTIVITY CONCENTRATIONS IN THE OHIO RIVER DURING FIRST QUARTER 1960

(Average concentrations in μμc/liter)

Station	Number of samples	Suspended	Dissolved	Total
Upstream:				
Phillips	12	3.8	5.2	9.0
Shippingport Intake ..	12	5.0	5.8	11
Downstream:				
Midland	12	4.8	7.8	13
E. Liverpool	12	3.0	7.8	11
Dam No. 7................	12	4.8	5.1	9.9

Analyses of each river water sample include a measurement of potassium-40. This radioactive isotope is the principal radioactive material that occurs naturally in the environment. During the quarter the average concentration of potassium-40 in the water was found to be 3.6 μμc/liter.

In addition to the routine gross radioactivity analyses of composite weekly samples, three Ohio River grab samples were collected during the quarter and determinations made on a number of specific radioactive isotopes of interest. Samples were collected upstream and downstream from Shippingport on March 9, 1960, and at Wheeling, West Virginia on March 14, 1960. The results of these analyses are summarized in the table below. It should be pointed out that the numerical results under the isotope headings marked with an asterisk(*) indicate upper limits for that isotope than the absolute value for the species. Other radioactive isotopes of similar chemical characteristics are present and the results actually indicate the total concentration of a group of chemically similar radioactive isotopes. For example, the results for strontium-90 also include strontium-89 and possibly other similar radioactive materials of lesser importance.

TABLE 3.–CONCENTRATION OF RADIOISOTOPES IN THE OHIO RIVER DURING FIRST QUARTER 1960

(Average Concentrations in μμc/liter)

Station	Strontium-90*	Cobalt-60*	Cesium-137*	Iron-59*	Tritium	Potassium-40
Upstream	1.0	1.9	0.1	6	0	2.5
Downstream	1.0	1.2	0.1	5	0	2.5
Wheeling, W. Va.	0.4	1.2	0.2	0	0	2.8

Area Monitoring

During the first quarter of 1960, four monitoring stations were used to continuously monitor and record background levels of beta-gamma radiation and levels of airborne particulate radioactivity in the vicinity of the Shippingport site. The data recorded by each station during this period were checked and tabulated on a weekly schedule.

The plant incinerator used for burning contaminated combustible material was operated intermittently during the quarter. The exhaust from the incinerator passes through a wet gas scrubber and a filter and is monitored at the stack exit during operation to determine the quantity of particulate radioactivity discharged. During the first quarter of 1960, the maximum particulate radioactivity monitored was 46 μμc/m^3. This concentration is less than the maximum permissible concentration for off-site airborne particulate radioactivity of 100 μμc/m^3 as recommended by NCRP.

TABLE 4.—AIRBORNE PARTICULATE RADIOACTIVITY

(Average concentrations in $\mu\mu c/m^3$)

Period	Station			
	SE of Main Building	1/2 mi. SW of site	1/2 mi. NW of site	1/2 mi. NE of site
First quarter 1960	0.691	0.625	0.795	1.57

TABLE 5.—BETA-GAMMA BACKGROUND RADIATION LEVELS

(Average values in millirad/hour)

Period	Station			
	SE of Main Building	1/2 mi. SW of site	1/2 mi. NW of site	1/2 mi. NE of site
First quarter 1960	0.014	0.015	0.012	0.011

Fallout

Radioactive fallout was collected at four of the area monitoring stations. Samples are collected from each station weekly and represent a sample period of one week. The following table indicates the data obtained from analyses of samples collected at these stations during the first quarter of 1960.

TABLE 6.—BETA RADIOACTIVITY IN FALLOUT DURING FIRST QUARTER 1960

(Average concentrations in $mc/mi^2/mo$)

Station	Number of samples	Activity
Upwind:		
1/2 mi. SW of Site	7	6.7
1/2 mi. NW of Site	13	9.0
Downwind:		
SE of Main Building............	13	7.5
1/2 mi. NE of Site	13	7.5

The prevailing wind direction at Shippingport is generally from West to East. Data from the upwind stations are compared to that from the downwind stations in an effort to determine any effect from the plant. The above results reveal no significant differences that would indicate a contribution from the plant to the radioactive fallout. Fallout that is routinely monitored is attributed to past weapons testing.

General Conclusion

As a result of the environmental monitoring program conducted by the Shippingport Atomic Power Station, it is concluded that the operations at this station did not adversely affect the radioactivity levels of the local environment.

180<

STRONTIUM-90 CONTENT OF ANIMAL FODDERS

Food and Drug Administration

The latest results by the Food and Drug Administration of their analyses of animal fodders for strontium-90 content is presented in table 1. Various fodders from nine states were collected by Food and Drug Inspectors and analyzed in their Washington laboratories. The May 1960 issue Radiological Health Data presented earlier data on strontium-90 in animal forage. Table 2 compares the strontium-90 content of hay and alfalfa with that of corn silage. The hay and alfalfa show a significantly larger amount of strontium-90 than the corn silage.

TABLE 1.--STRONTIUM-90 CONTENT OF ANIMAL FODDER

Food and Drug Administration

Source		Product	Date collected	Sr^{90} $\mu\mu$c/kg
State	County			
Idaho	Bonner	Ensilage	10/21/59	225
		Orchard Grass Timothy Hay	10/21/59	1,167
	Boundary	Silage	10/21/59	152
		Chopped Alfalfa Hay	10/21/59	251
Minnesota	Becker	Timothy & Alfalfa Hay	10/13/59 1959 crop	502
		Corn Silage	10/13/59 "	28
	Clay	Corn Silage	10/13/59 "	30
	Wilkin	Corn Silage	10/13/59 "	29
Missouri	Camden	Alfalfa Hay	11/3/59	35
		1/2 Corn & 1/2 Sorghum	11/3/59	20
	Pulaski	Corn Silage	11/3/59	482
		Lespedeza Hay	11/3/59	617
	Laclede	Prairie Hay	11/3/59	732
		Corn Silage	11/3/59	45
	Hickory	Lespedeza Hay	11/4/59	635
	Dallas	Lespedeza Hay	11/4/59	875
		Sorghum Silage	11/4/59	49
	Webster	Red Clover Hay	11/4/59	147
	Wright	Corn Silage	11/4/59	138
		Lespedeza Hay	11/4/59	776
New York	Schoharie	Sorghum Silage	10/20/59	38
		Alfalfa & Timothy Hay	10/20/59	176
		Corn Silage	10/20/59	114
	Montgomery	Corn Silage	10/21/59	221
		Timothy Hay	10/21/59	355
	Schenectady	Corn Silage	10/21/59	100
		Timothy Hay	10/21/59	698
	Albany	Corn Silage	10/23/59	83
		Clover & Timothy Hay	10/23/59	225
North Dakota	Cass	Alfalfa Hay	9/14/59 1959 crop	300
		Corn Silage	9/14/59 "	19
	Ransom	Corn Silage	10/14/59 "	80
		Alfalfa Hay	3rd Cutting 10/14/59 "	297
Ohio	Pike	Soy Beans	3rd Cutting (Sown 5/20/59) (Harvested 11/15/59)	27
		Bulk Corn Silage	(Sown 5/1/59) (Harvested 7/20/59)	42
		Bulk Alfalfa Hay	(Sown 1956 or 1957) (Harvested 7/1/59)	400

TABLE 1.--STRONTIUM-90 CONTENT OF ANIMAL FODDER--Con.

Food and Drug Administration

Source		Product	Date collected	Sr^{90} μμc/kg
State	County			
Ohio--Con.	Warren	Bulk Alfalfa & Red Clover	(Sown 3/58)	267
		Silage	(Harvested 5/59)	302
		Bulk Hay, Red Clover &	(Harvested 5/59)	
		Alfalfa Hay		
	Clinton	Bulk Orchard Grass &	(Sown-1957)	166
		Clover Silage	(Harvested 6/59)	
		Bulk Clover & Timothy Hay	(Sown-2/58)	377
			(Harvested 6/59)	
	Fayette	Bulk Corn Silage	(Sown 5/59)	21
			(Harvested 8/59)	
		Bulk Timothy & Clover Hay	(Sown 1958 & Spring 1959)	
			(Harvested 6/59)	365
	Ross	Bulk Orchard Grass, Ladino	(Sown 1956 or 1957)	
		Clover & Alfalfa Silage	(Harvested 6/15/59)	151
		Bulk Alfalfa Hay	(Harvested 6/15/59)	170
	Brown	Grass Ensilage	(Harvested 6/59)	510
South Dakota	Codington	Alfalfa Hay	9/16/59	450
	Deuel	Alfalfa Hay	9/17/59	267
Washington	Spokane	Ensilage, Alfalfa 1/2	10/21/59	188
		Alfalfa Hay & 1/2 Grass	10/21/59	233
	Stevens	Ensilage	10/22/59	285
		Oat Hay	10/22/59	73
		Alfalfa Hay	10/22/59	530
	Pend Orielle	Ensilage	10/23/59	105
		2/3 Alfalfa Hay 1/3 Grass	10/23/59	83
	Lincoln	Ensilage, Chopped Alfalfa	10/23/59	95
		Alfalfa Hay	10/23/59	221
Wisconsin	Walworth	Hay	11/13/59	504
		Corn Ensilage	9/22/59	34
	Jefferson	Alfalfa Hay	(Harvested 10/59)	305
		Corn Silage	(Harvested 10/5/59)	20
	Rock	Alfalfa Hay	11/4/59	412
		Corn Silage	11/4/59	49

TABLE 2.--COMPARISON OF STRONTIUM-90 CONCENTRATION IN ANIMAL FODDER BY STATES DURING 1959

State	Alfalfa, Hay Grass		Corn silage	
	No. samples	μμc Sr^{90}/kg	No. samples	μμc Sr^{90}/kg
Idaho	2	709	-	-
Minnesota	1	502	3	29
Missouri	7	545	5	147
New York	4	364	5	111
North Dakota	2	299	2	50
South Dakota	2	359	-	-
Ohio	9	303	2	32
Wisconsin	3	407	3	34
Washington	6	203	-	-
Weighted average	36	376	20	82

Index

VOLUME NO. I

Subject	Report No.	Page No.
Abstracts	2	46
Air:		
Argonne National Laboratory:		
September 1959 through January 1960	2	15
September 1959 through March 1960	5	11
April to June 1960	9	15
Atomic Energy Commission—*see* environmental levels of radioactivity.		
beta activity of particulates in air—*see* Argonne National Laboratory, Naval Research Laboratory, Public Health Service.		
Cincinnati air, radionuclide analysis of	2	46
fission product activity, daily record—*see* Naval Research Laboratory.		
National Air Sampling Network—*see* Public Health Service.		
Naval Research Laboratory daily record of fission product:		
β-activity for:		
November 1959	1	30
December 1959	2	8
January 1960	2	12
March 1960	4	81
April 1960	5	8
May 1960	6	24
June 1960	8	19
July 1960	9	13
radioactivity profile for:		
November 1959	1	33
December 1959	2	11
January 1960	2	14
February 1960	3	9
March 1960	4	83
April 1960	5	10
May 1960	6	26
June 1960	8	21
July 1960	9	15
publication of data, methods	2	20
Public Health Service:		
National Air Sampling Network:		
beta activity in precipitation	8	17
data for 1959	7	12
data for January-June 1960	8	14
description of	7	10
station locations	7	11
Radiation Surveillance Network:		
beta activity of particulates in air for:		
April 1956-Dec. 1959	4	36
November 1959	1	27
December 1959	2	6
January 1960	3	6
February 1960	3	10
	4	35
March 1960	5	6
April 1960	6	22
May 1960	7	8
Air—Con.		
June 1960	8	10
July 1960	9	11
description of	1	25
radon & thoron measurements at Cincinnati, Ohio for:		
November 1959	1	28
December 1959	2	7
January 1960	3	7
February 1960	4	80
March 1960	5	7
April 1960	6	23
May 1960	7	9
June 1960	8	11
July 1960	9	12
station locations	1	26
	2	5
sampling networks, list of	2	16
sampling station locations	2	22
Analytical Reference Service	6	54
Animas River	1	47
Body Burden		
cesium—potassium trends	7	63
Bone		
human, Sr^{90} activity in	2	32
	2	35
	4	89
Environmental Radioactivity:		
Aircraft Nuclear Propulsion Dept	8	32
Argonne National Laboratory	9	24
Bettis Atomic Power Laboratory	8	33
Brookhaven National Laboratory	9	26
Connecticut Aircraft Nuclear Engine Laboratory	8	36
Delaware River	7	64
Knolls Atomic Power Laboratory	9	27
Mound Laboratory	8	38
National Reactor Testing Station	9	31
Oak Ridge National Laboratory	9	33
Paducah Atomic Energy Laboratory	9	39
Portsmouth Gaseous Diffusion Plant	8	40
research on (AEC)	8	30
Savannah River Plant	9	41
Shippingport Atomic Power Station	4	107
	9	46
SIC Prototype Facility	8	43
Weldon Spring Plant	8	45
External Gamma Activity:		
see also environmental radioactivity.		
Radiation Surveillance Network:		
November 1959	1	45
December 1959	2	45
January 1960	3	32
February 1960	4	106
March 1960	5	17
April 1960	6	34
May 1960	7	32

Subject	Report No.	Page No.
External Gamma Activity—Con.		
Radiation Surveillance Network—Con.		
June 1960	8	29
July 1960	9	22
Fallout:		
AEC Studies	7	66
detonations of February and April 1960	7	66
radiation exposures from	5	44
Food:		
animal, Sr^{90} analysis	2	36
bread, Sr^{90} analysis	2	44
cereals, Sr^{90} analysis	4	97
consumption of:		
Northeastern and North Central U. S.	6	37
Southern and Western U. S	7	45
United States	5	26
diet	7	41
fish, Sr^{90} in	1	46
	4	97
human, Sr^{90} analyses	2	36
	4	93
meals	4	95
milk—*see* milk.		
radionuclide analysis	4	94
wheat—*see* wheat.		
Interpretations—*see* NCRP.		
Medicine:		
metabolic studies	8	51
radioisotopes in	5	18
Milk:		
Atomic Energy Commission—*see* HASL below		
Canadian.		
January, February, March 1960	6	7
April, May, June 1960	9	6
HASL (AEC):		
October 1959	1	10
November 1959	2	3
December 1959	3	3
January, February, March 1960	5	3
	7	5
April, May, June 1960	8	6
human, radionuclides in	8	6
Minnesota:		
September 1958—August 1959	1	11
September 1958—December 1959	4	32
January 1959--April 1960	9	5
networks, list of	1	14
Public Health Service:		
Milk Monitoring Network:		
added stations:		
Southeastern Radiological Health Facility for:		
April 1960	6	4
May 1960	7	4
June 1960	8	5
July 1960	9	4
Southwestern Radiological Health Facility for:		
March 1960	6	4
April 1960	6	5
May 1960	7	4
June 1960	8	4
July 1960	9	4
description of	1	7
	2	1

Subject	Report No.	Page No.
Milk—Con		
original stations:		
Robert A. Taft Sanitary Engineering Center, data for:		
May 1957—1960	4	10
November 1959	1	9
December 1959	2	2
January 1960	3	2
February 1960	4	9
March 1960	5	2
April 1960	6	3
May	7	3
June 1960	8	3
July 1960	9	3
publication of data, methods	1	16
sampling station locations	1	19
United Kingdom data	7	40
NCRP—ICRP, interpretative statements	1	1
Radiation protection criteria	4	1
Research—*see* environmental radioactivity, fallout, medicine.		
Soils		
fission product radioactivity in, for:		
1957-1960	4	99
August—November 1959	1	46
December 1959-February 1960	2	45
March—April 1960	4	106
May—June 1960	9	24
publication of data, methods	5	22
sampling networks, list of	5	20
sampling station locations	5	24
State Activities in Radiological Health	5	34
Strontium-90—*see* bone, food, wheat.		
baby foods	7	41
daily intakes	7	33
determination of	2	46
fodder, animal	2	36
United States diets	7	39
Training, Short Term	8	51
Uranium:		
mill discharges	1	47
Water:		
cistern samples	3	21
	4	88
Minnesota	1	40
National Water Quality Network, PHS:		
alpha and beta determinations for:		
October 1959	1	37
November 1959	2	30
December 1959	3	19
January 1960	4	86
February 1960	5	14
March 1960	6	30
April 1960	7	18
May 1960	8	24
June 1960	9	19
description of	1	35
Sr^{90} for quarter ending:		
September 30, 1959	1	37
December 31, 1959	3	19
March 31, 1960	6	30
June 30, 1960	9	19
Nevada Test Site, Sr^{90} for:		
November-December 1959	1	41

Subject	Report No.	Page No.
Water—Con.		
January-April 1960	6	32
May-June 1960	8	24
publication of data methods	3	24
sampling programs, list of	3	22
sampling station locations	3	28
surface	7	20
tap water:		
New York City:		
September 1959	1	40
December 1959-March 1960	5	16
April-June 1960	9	21
Water—Con.		
Richmond, California		
December 1959-March 1960	5	16
April-June 1960	9	21
uranium mill discharges	1	47
Wheat:		
daily intake	7	35
Sr^{90} in	2 2 7 8	40 37 34 47